GUIDELINES FOR REHABILITATION OF SMALL-SCALE FARMER IRRIGATION SCHEMES IN SOUTH AFRICA

TJ Bembridge

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by

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EXECUTIVE SUMMARY

1. BACKGROUND AND MOTIVATION FOR THE PROJECT

Despite huge investments the performance of most small-scale irrigation schemes has been poor and falls far short of the expectations of engineers, politicians, development agencies and the participants themselves. A few exceptions include small-scale sugar farms in KwaZulu-Natal and Mpumalanga.

A review of available literature reveals that not only is too little known about the performance of schemes, but that there is relatively little dissemination of information about experience gained, which would be useful in rehabilitating and modernising existing schemes, as well as planning new schemes. A general lack of cumulative experience with small-scale farmer irrigation schemes in South Africa is a constraint faced by planning and implementing agencies, as well as management. There have been few studies concerning the problems and impact of irrigation schemes which are useful to planners and developers. An important objective of the study was to contribute to a knowledge of the problems and constraints aimed at providing general guidelines for rehabilitating small-scale farmer irrigation schemes in South Africa.

Existing small-scale farmer irrigation schemes conform to one of five types : (1) top down bureaucratically managed schemes fully administered by government or an agency of government; (2) jointly managed schemes on which which some functions are performed by the irrigation development agency, while others are the function of project participants; (3) community schemes, usually small in size operated by water users themselves; (4) State or corporation financed schemes, such as sugar cane, where farmers are selected and Government provides infrastructure to field edge; and (5) large estate schemes, State or privately financed, and then managed by agents producing high return cash crops.

Because most of the present schemes fall into categories (1) and (2), the study focuses mainly, but not exclusively on four case studies in these two categories. The four study schemes selected were:-

1. Tyefu Irrigation Scheme, Peddie District, Eastern Cape
2. Sekgakgapeng Irrigation Scheme, Potgietersrust District, Northern Province
3. Thukela Estates Irrigation Scheme, Weenen District, KwaZulu-Natal
4. Bululwane Irrigation Scheme, Nongoma District, KwaZulu-Natal

Due to financial constraints over the past few years, provincial governments have withdrawn their support from a number of schemes. This has resulted in considerably reduced efficiency, and in some cases, complete collapse of certain schemes.

The main motivation for the study was that a large amount of capital has already been expended on some schemes which have already almost ceased to function, but which at the same time have the potential to make a significant impact on the local and national socio-economy, as well as in providing for food security, poverty alleviation and increased employment.

The aim of this study was to contribute to knowledge of the constraints facing small-scale irrigation schemes, particularly 'top down' bureaucratically managed schemes, aimed at devising guidelines and strategies to rehabilitate and modernise small-scale farmer irrigation schemes in South Africa, which have either collapsed or partially collapsed due to a combination of economic, institutional and social problems.

Before schemes can be rehabilitated it is necessary to undertake an appropriate diagnostic analysis to pinpoint major constraints and problems as a basis for innovative changes in the design, concept, management and economic participation of farmers. The research aims of the study were:-

- The most central aim of the research was to identify present constraints and determine what needs to be done to rehabilitate various types of irrigation schemes. Such research involves investigating a number of inter-related variables.
- An assessment of present and previous institutional variables including structures, policies, availability of production inputs and the land tenure system.
- Investigate certain situational, personal, socio-economic, cultural, socio-psychological and communication variables which may have affected the viability of the schemes.
- Assess the managerial capacity of scheme participants.
- Examine the present agricultural production situation on the case study schemes.
- Evaluate the impact of the project on participants and non-participants in the case study schemes.
- Investigate the possibility of future participatory approaches to water management.
- Investigate the research, extension and training needs of present and future scheme participants.
- Assess the suitability and acceptability of alternative irrigation technology.
- Assess the economics and acceptability of various irrigation farming systems.

A final aim was to make recommendations on measures which need to be taken to rehabilitate and restructure small-scale farmer irrigation schemes, including training needs.

Due to lack of records and local information, financial and other constraints, it was not possible to undertake in-depth studies of individual farmer managerial capacity, the scheme impact on non-participants, training for future scheme participants, alternative irrigation technology, as well as the economics of alternative farming systems. These issues are at least partially referred to in this study, but will require further study and research.

2. METHODOLOGY

The first phase of the study concerned an overall review of small-scale farmer irrigation schemes in the Eastern Cape, KwaZulu-Natal and Northern Province. Unfortunately it was not possible to obtain complete data for the Northern Province. This was followed by four case studies selected by senior staff from agricultural departments as projects in need of investigation with a view to possible rehabilitation and modernisation.

The methodology used for obtaining information included a review of available literature and reports, personal in-field observations, as well as discussions with numerous role players. Data on schemes in the three provinces was obtained through a questionniare completed by senior agricultural staff.

Data for the four case studies was initially gathered from structured interviews with representative groups of participants, and where applicable, non-participants, from the respective communities. This was followed by a stratified sample interview survey of participant households on the four schemes. There was a high degree of correlation between the results of the group and questionniare surveys which adds validity to the qualitative reliability of the data. This suggests that structured group interviews are a useful means of obtaining participatory and rapid feedback on scheme problems and constraints.

3. SMALL-SCALE FARMER IRRIGATION SCHEMES IN THREE PROVINCES

One hundred and eighty four schemes comprising 36 735ha under irrigation were identified in the Eastern Cape, KwaZulu-Natal and the Northern Province. These schemes had a total of 22 355 participants and a population of approximately 134 130 persons. Unfortunately complete up-to-date information was not available from the Northern Province.

The study revealed a host of problems and constraints, including water reliability and reticulation problems, deterioration of physical infrastructure, institutional and management problems, as well as socio-economic constraints. All these constraints

resulted in considerably below optimum levels of production. As a generalisation, the sugar cane schemes funded mainly by the KwaZulu Department of Agriculture with capital loan funding from the KwaZulu Finance Corporation tended to be more successful than other schemes. This was largely due to better support services from the Sugar Association Financial Aid Fund, a readily available market, as well as certain support from the sugar companies.

In this study "commercial farmers" were defined as those with plots of one or more hectares. On this basis 49% mainly in the Northern Province, could be classed as commercial farmers. Food plots can become commercially orientated, if participants are keen and enthusiastic and able to manage their plots efficiently.

Because of financial constraints, as well as in some instances, the complete withdrawal of management and finance by Agricultural Departments over the past five years, many small-scale farmer irrigation schemes in the three provinces have deteriorated and others have collapsed. Irrigation equipment has deteriorated, and inputs and efficiency are low, resulting in low levels of productivity. The latter varied considerably between individuals.

Problems and constraints on larger schemes (>50ha) tended to centre around poor maintenance of infrastructure and equipment, high energy costs, lack of institutional support in terms of credit, marketing, and draught power, lack of extension and farmer training, as well as local conflict and weak local organisations. Problems of soil and water salinity also occurred.

On the smaller schemes, problems were of a similar nature, with somewhat less emphasis on poor maintenance of equipment and infrastructure. On some of these schemes, theft and animals causing damage to crops, as well as local and political conflicts were cited as constraints.

Understandably, the need to upgrade infrastructure and equipment on all schemes was perceived as the major need to modernise and rehabilitate projects. Other needs include conflict resolution, farmer training, greater farmer participation, and improved training of extension workers. Security of land tenure and improved markets were also mentioned as important needs on larger schemes. On the smaller schemes there was a particular need for improved fencing to prevent animals causing damage to crops, as well as provision of farm inputs and greater farmer participation.

In Kwazulu-Natal some 40% of schemes were based on sugar cane production which has a ready market. On the other schemes in the three provinces a wide range of crops and vegetables were produced. Maize was invariably the main staple food crop. Crop yields on the sugar schemes were reasonable, although there were a number of farmers with poor management, especially inadequate weed control, resulting in uneconomic yields. On other schemes yields were extremely variable due to lack of resources, including inputs and credit, as well as low levels of management and poor irrigation and crop farming techniques. In the Eastern Cape and KwaZulu-Natal a large percentage (circa 70%) of

participants on non sugar schemes achieved yields considerably below potential for the previously mentioned reasons.

Data from this survey leads to the conclusion that successful small-scale farmer irrigation schemes depend on integration between technology, management, participants and the socio-economic situation.

4. TYEFU IRRIGATION SCHEME

The Tyefu irrigation scheme is designed to provide bulk water to irrigate some 5400ha on the east and west banks of the Great Fish river. At present the scheme is divided into five sections comprising 29 commercial farmers with 4ha land allocations and 1485 food plot holders with units of between 0,16 and 0,25ha.

From the outset it was realised that the scheme was not economically viable. However, because of considerations of poverty alleviation and the fact that in due course the present high cost pumping scheme would be superseded by a gravity canal system, the previous homeland government decided to proceed with the scheme. The scheme managed by consultants functioned reasonably well in the early years. Due to financial constraints the Eastern Cape government decided to disband the then managing agents, ULIMOCOR, in 1995.

The scheme is situated in an area of extreme poverty. The climate and soils are suited to the production of a wide range of crops and vegetables.

The present water supply system is inadequate for sustained irrigation from May to October in years of low rainfall. The high cost of electricity for pumping water from the Great Fish river make the scheme completely uneconomic. The quality of water during periods of low flow is such that it presents a salinity problem.

The development of the irrigation scheme has resulted in infrastructural development, including electricity supply, schools, health services and retail outlets, which otherwise may not have reached this remote area. After 15 years much of the above ground piping and equipment is in poor condition and needs to be upgraded and replaced.

Farmer leadership was generally weak. This was compounded by political rivalry between farmers' unions.

Participants had divided perceptions on scheme impact and whether they had benefitted from the scheme, as well as on the effectiveness of previous management. They were unanimous that the scheme should be rehabilitated, that there should be greater farmer participation in managing the scheme, on the need for land tenure reforms, as well as the need for improved institutional support.

An evaluation of extension workers on this scheme as well as a scheme in KwaZulu-Natal revealed many shortcomings in their competency to advise irrigation farmers.

Thirty per cent of heads of households were widowed and 37% were over the age of sixty years. The majority (57%) were illiterate. Monthly expenditure and savings were low. A large proportion of income was derived from pensions and spent on food. Three in five households were estimated to be living below the poverty datum line. Farmers had very limited resources in terms of livestock and equipment.

It was concluded that in the long term the only means of reducing pumping costs and preventing soil salinity was to extend the pipeline from the Glen Boyd dam to supply the areas presently dependent on pumped water from the Great Fish river.

Rehabilitation of the scheme is only justified as a poverty relief and food security measure, provided the cost of present development and rehabilitation costs are written off. Detailed conclusions and recommendations are given in the text, as well as in the final chapter

5. SEKGAKGAPENG IRRIGATION SCHEME

The 28ha centre pivot irrigation scheme near Potgietersrust in the Northern Province was established in a fairly top down manner during 1984 and allocated to 14 farmers who were prepared to farm on a full-time basis.

Because of pressures from non-participants in the Sekgakgapeng community, possibly due to the clamour for additional land, the scheme was sabotaged in 1995 and has not operated since.

The climate is suitable for a wide range of field and vegetable crops and is situated near a ready market. Due to saline water, some of the soils were found to have a high sodium content. The original water supply was from pumping from a large vlei area in the Mogalakwena river. During a drought period six boreholes were drilled and equipped, none of which are functional at present.

The present irrigation committee comprises 7 farmer members. One in five participants were widow-headed households, with 30% over 60 years of age. Sixty five per cent were functionally illiterate.

Closure of the scheme has resulted in a considerable reduction in household income to the extent that 65% are estimated to be living below the poverty datum line, despite 47% of households receiving pensions. Although 2 farmers possessed tractors, in general they had limited resources.

The general feeling was that the centre pivot scheme was not ideally suited to individual farmers, because of the lack of freedom of choice in growing crops.

Interviews with non-participant groups in the local community showed dissatisfaction with the original allocation of plots. They felt that opportunities should be created for greater local involvement both in rehabilitating the scheme, as well as participating in irrigated food plots.

Allowing for interest and redemption payments and replacing the existing centre pivot with a quick coupling drag line system, and providing mini-sprinklers for food plots, the scheme is potentially viable. However, before modernising the scheme, the quality and quantity of the water supply will have to be fully investigated. In addition, it will be necessary to restructure the local committee into a fully fledged Water User Association with wider community participation to gradually take over the management of the scheme.

6. BULULWANE IRRIGATION SCHEME

The Bululwane Irrigation Scheme established some 33 years ago is located in the Nongoma district of KwaZulu-Natal. Zulu King Goodwill Zwelithini has one of his palaces in close proximity to the scheme, and also has a plot on the scheme.

The scheme is gravity fed by canal from the Bululwane river. Water shortages are sometimes experienced in August and September. The climate is suited to a wide variety of crops. However, some of the soils are only of marginal suitability for flood irrigation and require further investigation. Approximately 80% of the 345ha is not being utilised at present due to a combination of lack of motivation and a lack of resources and support services. On average, farmers were allocated units of approximately one hectare.

Due to the age of the scheme, canals and distribution sluice gates have become worn and corroded and are badly in need of repair. In addition to wear and tear in the canals the main storage dam and the silt dam have become silted up. A start has been made on rebuilding the main canal and patching up other areas, as well as secondary canals. However approximately R2 million is required to completely rehabilitate the irrigation and ancillary works.

Fifteen per cent of households were widow-headed. Two in five heads of household were over 60 years of age and 58% were illiterate. The socio-economic situation was marginally better than on the other 3 case study schemes, with approximately 50% living below the poverty datum line. Sixty per cent of households were in receipt of pension income and one in five were in employment. They also owned larger numbers of cattle and equipment than on comparative schemes.

Crop production income only comprised a small proportion of total household income and crop yields were considerably below potential.

A major advantage of the scheme is that it has a gravity flow supply system with low water distribution costs. Scheme participants were unanimous that the scheme should be

rehabilitated and the majority felt management of the scheme should, over time, be taken over by the farmers themselves.

Discounting expenditure to date on rehabilitation works, as well as capital still required to complete the rehabilitation exercise, the scheme is considered potentially viable from a poverty alleviation point of view. However, to be successful, this will require the institutional support suggested in the final section of this report.

7. THUKELA ESTATES IRRIGATION SCHEME

The 813 hectare Thukela Estates irrigation scheme has a long history going back to 1912. In 1985 the responsibility for the scheme reverted to the KwaZulu Department of Agriculture. A number of attempts have been made in the past to revitalise and rehabilitate the scheme. Apparently institutional problems relating to land allocation, inappropriate management, lack of participation and local conflicts have led to failure. Virtually all of the 1275 households living near the scheme have been allocated small plots of varying sizes.

Because of the lack of maintenance and deterioration, the original canal is no longer functional and only about 30% of the productive area is being utilised by pumping from the Tugela river. Many potential participants are unable to irrigate due to the collapse of the main supply canal and ancillary works. The pressurised system is in a poor state of repair and disfunctional. More recently, lack of unity and stability within the community due to faction conflicts have hindered this study, as well as rehabilitation of the scheme.

Although the area does experience frosts during winter, the climate is suited to a wide variety of crops and vegetables. With sound irrigation management suitable soils are not a constraint on this scheme. Likewise, the quality and potential quantity of water from the Tugela river do not impose a constraint to the rehabilitation and modernisation of the scheme.

The original main canal has been repaired to field edge. It is estimated to cost over R5,3 million to fully repair the main canal to command approximately 550 ha. Approximately 274ha is irrigated from the 4 pump stations all equipped with electric pumps. Much of the piping is in a poor state of repair and has been in disuse for some years. The pump stations are prone to flooding with resultant high maintenance costs. Pipelines often break due to the class of piping and poor installation.

There was complete unanimity among participant groups that the scheme should be rehabilitated by repairing and upgrading the infrastructure. The expectation was that this would result in food security for the community in this area of extreme poverty. It was estimated that 86% of households were living below the poverty datum line. There was an extremely high level of illiteracy (91%) among heads of households, of whom 21% were widow-headed and one-third over sixty years of age.

As with the other three case studies, the scheme is worth rehabilitating and modernising as a poverty alleviation measure, provided the interest and redemption of the R7,74 million capital required is written off. However, before this can take place the conflicts within the community need to be solved and the necessary institutional support services put in place.

8. CONCLUSIONS AND RECOMMENDATIONS

A comparison of data from the four case study schemes revealed many common problems. There was common consensus on the main project objectives of food security, increased incomes and development of farming skills. Except for commercial farmers on two of the schemes, plot sizes were too small to derive a living from agriculture alone. There were problems of marginal soils, drainage and water quality which need to be resolved before rehabilitation can take place. Irrigation infrastructure was generally in a poor state of repair and either partially or completely non-functional. The viability of modernisation and rehabilitation is justified on poverty relief grounds provided the interest and redemption of rehabilitation costs is completely subsidised.

There were common problems of a high proportion of heads of households in the upper age groups (>60 years) and high levels of illiteracy. A large proportion of households were living below the minimum subsistence level, had low levels of savings with a large dependency on pension income, as well as below potential levels of income from farming. Employment levels were low and farmers had limited resources.

Probably due to the poor state of the infrastructure there was general dissatisfacation among participants concerning scheme management, and the general lack of farmer participation in scheme management and maintenance. There was also general dissatisfaction with institutional support services including extension, training, research, markets, credit, farm inputs, mechanisation services and land tenure. There was complete unanimity that the individual schemes should be modernised and rehabilitated.

The over-view of schemes in the three provinces, as well as the four case studies reported on shows that, with the exception of sugar cane schemes in KwaZulu Natal, which have a ready market and good support services, many of South Africa's small-scale irrigation schemes are in a state of crisis. The near or complete collapse of schemes due to a combination of lack of funding, poor management and maintenance of infrastructure, as well as inappropriate organisation, has led to low productivity and poverty.

The process of rehabilitation planning and modernisation is complex and diverse. It is difficult to provide definitive guidelines to suit all schemes. No two schemes are the same. In the final section of this report a check-list and discussion of the basic elements to be considered in rehabilitating selected irrigation schemes are put forward. These include:-

- Sustainable irrigation rehabilitation should be integrated as part of the whole process of area and rural development, including consultation with the various role players and a participative approach to feasibility studies, planning and implementation.

- A thorough understanding of the socio-economic situation is an essential pre-requisite for scheme rehabilitation.

- After identifying key informants and local groups, it is important, through structured interviews, and if necessary, household sample surveys, to establish approximations of age structure, education and literacy, managerial ability, the role of youth, gender issues, poverty indicators, labour, health, land tenure and various perceptions. An analysis of these variables will establish constraints as well as determining the likelihood of overcoming constraints through training and assistance which may support or otherwise facilitate efforts to rehabilitate the scheme concerned. An example in the study was the need to encourage younger scheme participants.

- It is important to recognise any potential negative impacts on the natural environment, such as soil erosion, destruction of vegetation, water pollution and water borne diseases.

- An assessment of soil suitability and climate is fundamental to the success of all schemes. On schemes where marginal soils exist, the use and potential of such soils should be fully investigated before implementation of a rehabilitation programme.

- A knowledge of present cropping patterns, including inputs, yields and constraints is important for future planning and implementation. This includes an assessment of farmer resources.

- In order to establish the suitability of present and proposed crops, information is required on temperature, rainfall and consumptive use of water through available data or by interpolation from the nearest available data.

- Before considering rehabilitation it is important to establish present constraints on crop production, including endemic pests and diseases, soil, climate, labour, draught power, inputs, marketing and agricultural services, which unless remedied, are likely to continue to be experienced in the future.

- Effective marketing is crucial to obtaining high gross margins. Both local and external marketing potential needs to be fully investigated.

- It is vital to clearly establish the quality, availability and reliability of the scheme water supply.

- A careful assessment needs to be made of scheme infrastructure, including water distribution and irrigation methods. Designs should be specific to community needs and resources and will often require professional assistance. There should be full community participation in any construction and implementation.

- In considering the viability of rehabilitating individual schemes it is important to assess the present situation without rehabilitation, as well as the projected value to participants if the scheme is rehabilitated. Consideration should be given to alternative poverty alleviation measures.

- Farmer participation should take place at all stages of the rehabilitation process and may take up to three years to implement. Participation should be through establishing Water User Associations (WUAs), and should be looked upon as a "learning process". There will be a need for flexibility and experimentation. Sustainability is likely to depend not on total self-reliance, but initially on a new mixture of local resources with limited external support.

- The new National Water Act makes provision for the formation of WUAs. On all schemes undergoing rehabilitation WUAs need to be formed in consultation with local communities. On large schemes there is a need to form Block Committees responsible to WUAs for water distribution, and be represented on the WUA. A concerted training programme for WUAs and Block Committees is fundamental to succesful scheme rehabilitation.

- On most schemes there is a need initially to appoint a facilitator/manager to act as a catalyst in identifying specific needs and problems, initiate, observe, guide, evaluate, provide alternatives and generally assist WUAs and Block Committees in the transformation process and making decisions and acting on them.

- It is important that the WUAs, Block Committees and the local community are consulted and involved in the whole exercise of upgrading infrastructure.

- Over time the operation and maintenance of the scheme should be undertaken by the WUA. Initially a concerted training and assistance programme will be necessary, until such time that WUA staff have the necessary competence to take over these functions.

- The availability of both short term and medium term credit for seasonal production costs and scheme rehabilitation respectively on a selective basis, is fundamental to successful scheme rehabilitation.

- An important role of WUAs is to liaise with input suppliers to supply appropriate inputs in bulk, at reasonable cost and in good time for the season.

- Lack of adequate ploughing services is often a serious constraint. It is incumbent upon WUAs to negotiate with contractors, as well as investigate the possibility of using ox drawn tillage and small tractors.

- A pre-requisite for successful scheme rehabilitation is to place well trained competent extension officers on the scheme, who together with the project facilitator, can commence training farmers from the outset.

- On-farm research is a much neglected, but essential part of small-scale farmer irrigation scheme development. Research is needed, not only in new and alternative high value crops, but also in determining real crop water requirements, and developing integrated farming systems.

The suggested model fulfils the objective of the investigation in providing guidelines for modernisation and rehabilitation of small-scale farmer irrigation schemes in general. If one or more elements in the model are inadequately addressed the rehabilitation exercise is unlikely to be wholly successful. Empowerment and capacity building are crucial to successful rehabilitation, continuity and sustainability of small-scale farmer irrigation schemes.

A step-by step guideline for the participation process for successful rehabilitation and long term sustainability of small-scale farmer irrigation schemes is suggested.

The initiative for planning and implementing the rehabilitation of small-scale farmer irrigation schemes lies with Provincial Agricultural Departments. They need to liaise with local structures, the Department of Land Affairs and the Department of Water Affairs and Forestry, the Agricultural Research Council, as well as the Land Bank, private sector and other relevant role players in facilitating the rehabilitation of selected irrigation schemes.

CHAPTER I

INTRODUCTION

1.1 SMALL-SCALE FARMER IRRIGATION SCHEMES IN AFRICA

1.1.1 Introduction

Approximately 40% of the world's food production comes from the 260 million hectares of irrigated lands. Total irrigated area on the African continent is estimated at 12,4 million hectares (FAO,1995) of which 5.02 million ha (40%) are in Sub-Saharan Africa, excluding 1,3million ha (26%) in South Africa (Backeberg, 1994)

According to a World Bank study the performance of small-scale farmer irrigation systems has generally been below expectations, producing low economic and financial returns and discouraging investment in irrigation (Serageldin, 1995).

The largest production and farm incomes from irrigation schemes have been in Asia and Latin America. In Africa no comparable levels of productivity have taken place and performance has been disappointingly low (FAO,1995).

It was not within the terms of reference of this study to document an evaluation of small-scale farmer irrigation projects in Africa. More important, are the lessons to be learnt from past failures. In any event, and in Africa in particular, a review of available literature reveals that not only is too little known about the performance of schemes, but that there is relatively little dissemination about experience gained, which would be useful in planning new schemes. Much of the planning, design and construction of irrigation projects in Africa has been carried out, in one form or another, by external agencies.

Whilst governments and development agencies have given extensive consideration to the technological aspects of irrigation projects, they have virtually ignored the all important "human" dimension (Overseas Development Institute, 1985). Due to its very nature, irrigation development is particularly prone to human problems.

1.1.2 Lessons from Africa

Bureaucratically managed schemes are by far the most prevalent in Africa. With few exceptions, and in particular, bureaucratically "top down" managed schemes, the economic success of irrigation projects falls far short of the expectations of planners, politicians and development agencies. Even among the few relatively successful projects there appear to be increasing ecological and social problems which will eventually have economic effects (von Harder, 1983).

More than a decade ago it was recorded by Moris, Thom and Norman (1984) that the African continent was littered with derelict irrigation schemes; for the most part the

record of such schemes was reported as being dismal (Heyer, Roberts and Williams, 1981). It appears that the situation is little different today.

For example, in Nigeria after the 1988 abrupt government withdrawal from operating and management of the large schemes contributed to deterioration of irrigation structures and acute low level performance of many schemes. In all, the involvement of farmers in managing most irrigation schemes has been very informal and almost non-existent in many cases (Ogunwale, Maurya and Owunubi, 1994).

Reports of other schemes in West, East and Central Africa , with few exceptions, such as the Mwea project and Mumias sugar scheme in Kenya, show a similar situation to that pertaining in Nigeria (Bembridge, 1986a). Experience in Senegal has demonstrated the importance of achieving optimum scale in irrigation development, where it has been shown that small units with a maximum of 120 members have proved successful (Diemar and van der Laan, 1983). A similar experience has occurred in Zimbabwe (Mupawose, 1984).

Available literature on irrigation schemes in other African countries such as the Sudan (Gezira and Rachad), Mali, Niger (Niger Valley), Ghana (Volta Lake and Afife), the Gambia, Tanzania, Malawi, Madagascar and Swaziland all show varying combinations of problems, including scheme management, project planning and design, security of tenure, size of units, farmer participation, water management, debt load, pricing policies, marketing, inputs, extension services, as well as mechanical and support services (Bembridge, 1986a).

A general conclusion is that most of the small-scale farmer irrigation schemes in Africa have performed poorly in terms of production and management and have failed to achieve predicted production levels (UK Department of International Development, 1998). There is a large gap between projected and actual performance. Generally, projects have been beset by problems resulting from low participation by farmers.

Although there is a need for caution in arriving at conclusions on the basis of available literature, a number of generalisations can be made concerning the socio-economic constraints on small-scale farmer irrigation in Africa:

- In general, there are more institutional, social and economic problems in large-scale projects than in smaller schemes.

- While large projects have economies of scale, the larger the size of project, the more anonymous the decision making process becomes, the higher the administrative costs, and the greater chance of mismanagement and problems of relationships between management and farmers.

- A number of the problems in African irrigation schemes can also be attributed to problems in the project planning process. Irrigation development projects are frequently imposed from above.

- Socio-economic surveys conducted at the early stages of irrigation planning rarely provide adequate guidelines.

- Traditional land tenure systems and rigidity concerning size of unit are often a severe constraint upon irrigation development. Insecurity of tenure has proved a serious problem on many projects, such as Gezira (Sudan) and Mwea (Kenya), where farmers are basically no more than tenants.

- Choices of technology are often inappropriate and not geared to obtaining optimum economic yields.

- An immediate criticism of irrigation projects in general is the "top down" approach, based largely on national and economic objectives, which are often not in accordance with the goals and needs of scheme participants.

- A general conclusion is that the historical origins of irrigation schemes, the types of crops grown, the sources of irrigation water, the size of schemes, and the types of energy used are less important conceptually than the *problem of effective project management.*

- Other factors affecting project success are the means of payment for produce, suitable marketing channels, and provision of credit.

From the African experience it can be concluded that successful irrigation development depends on integration between technology, management, participants, and the overall socio-economic situation. There is no doubt that the problems encountered on irrigation schemes can be solved by learning from past mistakes, and that, consequently, irrigation can make a valuable contribution to agricultural development on the continent.

1.2 SMALL-SCALE FARMER IRRIGATION IN SOUTH AFRICA

Small-scale farmer irrigation schemes in South Africa comprise only approximately 46 000 ha or 4% of the total area irigated. However, from a rural development and socio-economic point of view such schemes are of cardinal importance, since more than 223 000 people are dependent at least partially for a livelihood from small-scale farmer irrigation schemes. Despite huge investments the performance of most small-scale farmer irrigation schemes has been poor. Research has shown that small-scale farmer irrigation schemes are beset by varying combinations of economic, institutional and social problems (Bembridge, 1986a).

A review of the limited literature available shows that with a few exceptions, the economic success of small-scale farmer irrigation schemes in South Africa falls far short of the expectations of planners, politicians, development agencies and the participants themselves (Bembridge, 1996). There have been few studies concerning the impact of irrigation

schemes which are useful to planners and developers (Bembridge, 1986b). A study such as this has the potential to contribute to knowledge of the constraints, and provide guidelines for strategies to rehabilitate small-scale farmers' irrigation schemes in South Africa.

Existing small-scale farmer irrigation schemes in South Africa conform to one of five types:

1. **'Top down' bureaucratically managed smallholder schemes** fully administered by government or an agency of government. Practically all farming operations are carried out by the management on behalf of farmers. Usually there is no selection of participants on the basis of farming ability. The majority of schemes in South Africa conform in varying degrees to this category. Such projects have high recurrent costs and returns to farmers are only a fraction of recurrent costs.

2. There are a number of **jointly managed schemes in which some functions are performed** by the irrigation development agency, while others are the function of project participants. Such schemes are usually aimed at eventually developing farmers to produce their own food and a surplus for sale. There is also little selection of farmers on farming ability. This type of scheme is usually a large financial burden to the State.

3. **Community schemes** are usually small in size, operated and maintained by the water users themselves and/or their representatives. There are relatively few such schemes.

4. **State or corporation financed schemes,** such as sugar cane, where farmer participants are selected on entrepreneurial and farming ability, as well as on their financial and other resources. Government provides infrastructure to field edge. Farmers pay a subsidised water charge and farmers are left to their own decision making and management. Such schemes are rare in South Africa.

5. There are a number of **large estate schemes**, which are State or private sector financed, often managed by agents aimed at maximum use of resources through production of high return cash crops such as tea, coffee and various fruit and vegetable crops. Although some schemes have a number of outgrowers on a pilot scheme basis, there is generally little farmer participation, except in the form of supervised labour.

From a human development point of view, it is clear that the focus should be on jointly managed schemes, small community schemes and entrepreneurial schemes. Large estates have a place provided the long term objectives include training and development by individual farmers. Because most of the present schemes fall into categories (1) and (2) above, the study will focus mainly, but not exclusively, on case studies in these two categories.

The main motivation for the study is that a large amount of capital has already been expended on some schemes which have already almost ceased to function, but which at the same time have the potential to make a significant impact on the socio-economy of the local community and the country as a whole.

Before schemes can be rehabilitated it is necessary to undertake an appropriate diagnostic analysis to pinpoint major constraints and problems as a basis for innovative changes in the design, concept, management and economic participation of farmers.

The rehabilitation of schemes has the potential to increase food security, individual household income, employment (including self employment), as well as to stimulate development in communities as a whole.

1.3 RESEARCH AIMS

- The most central aim of the research will be to identify present constraints and determine what needs to be done to rehabilitate various types of irrigation schemes. Such research involves investigating a number of inter-related variables.

- An assessment of present and previous institutional variables including structures, policies, availability of production inputs and the land tenure system.

- Investigate certain situational, personal, socio-economic, cultural, socio-psychological and communication variables which may have affected the viability of the schemes.

- Assess the managerial capacity of scheme participants.

- Examine the present agricultural production situation on the case study schemes.

- Evaluate the impact of the project on participants and non-participants in the case study schemes.

- Investigate the possibility of future participatory approaches to water management.

- Investigate the research, extension and training needs of present and future scheme participants.

- Assess the suitability and acceptability of alternative irrigation technology.

- Assess the economics and acceptability of various irrigation farming systems.

- A final aim will be to make recommendations on measures which need to be taken to rehabilitate and restructure the various types of scheme, including training needs.

In Chapter 2 the methodology used in the study is outlined. Chapter 3 provides an overview of small-scale farmer irrigation schemes in the Eastern Cape, KwaZulu Natal and Northern Province. In chapters 4,5,6 and 7 the results of four case studies are given.

In the final chapter some general suggestions and a check list are put forward for upgrading and rehabilitating small-scale farmer irrigation schemes.

CHAPTER 2

METHODOLOGY

2.1 INTRODUCTION

This Chapter outlines the methodology used to investigate the overall situation of small-scale farmer irrigation in the Eastern Cape, KwaZulu Natal and Northern Province, as well as for the four case studies. The choice of case study areas, orientation and planning of the survey, sources of information, sampling and interviewing procedure and analysis of the data are discussed.

2.2 CHOICE OF RESEARCH AREAS

Because of the many factors influencing farming systems and farming progressiveness, it is desirable that physical factors and land-use should vary as little as possible, in any comparative studies of social, socio-economic and socio-psychological variables. Irrigation schemes have the advantage that the provision of irrigation itself tends to even out major differences in climate, particularly rainfall.

As communities are the social units with which rural families identify themselves, the communities surrounding irrigation areas were used as the unit areas for this investigation. On account of the limitations imposed by time and cost, the study was initially restricted to one case study area in each province.

Because of instability in the community due to frequent faction fights, it became apparent that it would be difficult to complete an investigation of the Thukela Estates Irrigation Scheme. The Bululwane irrigation scheme was selected to replace this scheme. At the end of 1998 there was a cessation of conflict on the former scheme and it became possible to gather at least some meaningful data, which are included in this report.

The case study schemes selected by senior officials of agricultural departments were considered to have major constraints preventing rehabilitation of the schemes concerned.

The schemes selected were:-

1. Tyefu Irrigation Scheme, Peddie District, Eastern Cape.

2. Sekgakgapeng Irrigation Scheme, Potgietersrust District, Northern Province

3. Thukela Estates Irrigation Scheme, Weenen District, KwaZulu/Natal.

4. Bululwane Irrigation Scheme, Nongoma District, KwaZulu/Natal.

The above schemes are considered reasonably representative of the more difficult schemes for possible rehabilitation and upgrading.

2.3 ORIENTATION AND PLANNING

The orientation and planning of this study commenced in August 1997 and took approximately six months to complete. The object of this preparation stage was firstly, to review the literature on small-scale farmer irrigation, especially in Africa. Secondly, to consult senior officials in the three agricultural departments on selection of case studies and reviewing small-scale farmer irrigation schemes in the province.

2.4 INFORMATION SOURCES

A wide range of studies from Africa, Asia, and South America were consulted in the planning of this study. Published information on small-scale farmer irrigation schemes in South Africa is extremely limited, particularly concerning the all important socio-economic aspects. Data were obtained from the following sources:

- Available literature
- Personal in-field observations
- Questionnaire survey of irrigation schemes in each of the three provinces
- Available reports on the four case study schemes
- Structured group discussions with representative role players on each case study area
- Household sample surveys on each scheme
- Discussions with senior officials, extension staff, researchers, engineers and others concerned with small-scale farmer irrigation schemes.

2.5 ORIENTATION OF EXTENSION OFFICERS AND RURAL COMMUNITIES

Co-operation of local extension staff and local communities is a vital part of any rural research exercise, both for the research itself and for the implementation of the findings. The background, problems, motivation, objectives and method of the study were carefully outlined and discussed with all senior and field staff concerned with the four case study schemes.

Local leadership structures and community members were informed of the scope and objectives of the investigation, at meetings called especially for this purpose and attended by senior and local officials of the agricultural department concerned. Such meetings inevitably involved much discussion and many questions before the research proposals were accepted.

2.6 SELECTION AND TRAINING OF ENUMERATORS

Enumerators for the survey were selected by senior staff of each of the three agricultural departments. All enumerators participated in training sessions on interviewing techniques and procedures. The participation of interviewers in the study from the planning phase onwards ensured that they all understood the objectives of the surveys, the reason behind specific questions, and the need to follow through with non-directive probes.

In summary, the experience of this research exercise showed the importance of field interviewers in shaping the content and research among the rural people themselves. It was a good learning experience for all those involved in the study.

2.7 QUESTIONNAIRE OBJECTIVE AND DESIGN

A pro-forma was designed to obtain specific information on each small-scale farmer irrigation scheme in the three provinces.

Rapid Rural Appraisal surveys involving structured interviews with various groups of role players have proved a useful means of obtaining quick feedback from groups of role players. Interview schedules were designed to obtain perceptions of participants, and where applicable, non participants, on a wide range of issues pertaining to the rehabilitation of the irrigation scheme concerned. These variables included scheme impact, problem definition, farmer selection, land tenure, scheme management, participation, conflicts, local organisations, gender issues, political support and suggestions for rehabilitation. Where applicable, separate schedules were designed for scheme participants and non-participants (Appendix 1 and 2). Structured interviews are extremely useful in obtaining an appraisal of the overall situation, but have the disadvantage of not being able to quantify certain variables.

Questionnaires used in interviews have the advantage of flexibility, thus enabling the trained interviewer to ensure that the respondent understands the question and purpose of the study. This approach also permits the interviewer to probe further when particular responses are encountered, as well as allowing subjective assessments and ratings to be made of perceptions, attitudes, opinions, knowledge etc. There is also the undisputed advantage of fullness and spontaneity. Because a large percentage of heads of households were illiterate, interviews supplemented by structured group discussions, field observations, available records and reports, as well as expert opinion was the only feasible means of obtaining reasonably accurate information.

Besides the variables mentioned above which were included in the structured group interviews, sections of the heads of households interview schedule included personal and socio-economic variables, household resources, agricultural production, size of unit, security of tenure, decision making, future participation and management, training, water management and irrigation techniques.

Questionnaires were formulated in English and modified according to the situation on individual schemes. An example of the questionnaire used is given in Appendix 1.

The questionnaire was pre-tested in each area. Generally the questions were easily understood and readily answered, but, for the sake of absolute clarity, a few questions were rephrased. Questionnaires were checked and where necessary, discussed with the enumerators.

A questionnaire was designed to obtain feedback on the training needs of extension officers, and knowledge of irrigation techniques.

2.8 THE SURVEY

Generally speaking the structured group interviews went according to plan. The composition and number of groups interviewed are shown in Table 2.1.

Table 2.1 Structured group interviews by area, number of groups, participants and type of group, 1998.

Scheme	No. of groups	No. of participants	Type of group
Tyefu	9	108	Farmers unions
Bululwane	4	42	Farmers, dryland farmers, Indunas, councillors
Thukela Estates	6	72	Umbrella committee, block committees, food gardens
Sekgakgapeng	6	66	Tribal authority, SANCO, TLC,CD Forum, Youth, Policing Forum

In the case of Tyefu and Thukela Estates virtually all households in the community were participating in the irrigation schemes. Non-participant groups were interviewed in Bululwane and Sekgakgapeng. There is every reason to believe that the group interviews provided a fairly accurate perspective of the views of participants, and where applicable, non-participants, on the various issues concerned with rehabilitating and upgrading of the four case study schemes.

Problems were experienced with delays in the household survey on Thukela Estates, due to conflicts within the community. Subesequently it was possible to undertake a sample survey. In the case of Tyefu, transport proved to be a major constraint which was subsequently solved by funding from the research project budget.

2.9 SAMPLING PROCEDURE

2.9.1 The Frame

The choice of the population to be sampled is greatly influenced by the data base. Since lists of household participants and gender were the only available data base that identified individuals in each section of the irrigation scheme concerned, such lists were chosen as

the population figures for sampling on Thukela Estates, Tyefu and Bululwane schemes. In the case of Sekgakgapeng all participants (14) were interviewed. In the case of Thukela Estates, sampling was from lists of participants who were currently irrigating and those who were not, due to various technical and resource constraints.

2.9.2 Sample size

In considering sample size, factors such as costs and resources, as well as desired level of accuracy were considered. Available information from local extension officers indicated that the population in each irrigation section on Thukela Estates, Bululwane and Tyefu was fairly homogeneous.

Although an increase in sample size will clearly lead to an increase in the accuracy of the sample mean as an estimate of the population mean, the cost of field surveys also increases proportionally to sample size. Therefore, for practical purposes, sample size is determined by available resources and the accuracy required.

Table 2.2 Sample sizes according to scheme, 1998

Area	No. participants	No. sections	Sample size	Sample fraction
Tyefu	29 C.Fs [1]	5	24	83,0%
	787 FPHs		70	8,9%
Bululwane	340 FPH's	10	40	11,8%
Thukela Estates	403 I[2]	4	36	8,9%
	872 N-I	1	31	3,6%
Sekgakgapeng	18 CFs	1	N/A	100,0%

[1] C Fs = Commercial farmers - FPHs = food plot holders
[2] I = Irrigators N-I = Non irrigators

On the basis of a purely random sample, the sample size for Tyefu, Bululwane and Irrigators on Thukela Estates (Table 2.2) gives a tolerable sampling error of ± 4 per cent and ± 6 per cent for the non-irrigators on Thukela Estates, which is quite adequate for this type of investigation (Prewitt, 1980 : 36). Stratification of the sample according to gender and scheme section (Refer to para. 2.9.3), further adds to the efficiency of the sampling procedure, which can be considered more than adequate to determine the present situation with reasonable accuracy (Barnett, 1974).

2.9.3 Method of sampling

Sampling was done by random selection from lists of heads of households according to section and gender, taking the same sample fraction from each section. An exception was the Glenmore section on Tyefu, where no accurate list of participants was available. Here a simple random sample based on available information was taken.

2.10 INTERVIEWING PROCEDURE

Interviews with heads of households lasting on average 1½ hours, although quite long and tedious, were fairly straight forward. Enumerators conducted an average of two interviews daily. Some interviews had to take place at weekends. Some respondents used the interview to discuss personal problems. This was neither encouraged nor discouraged. Interviews ranged from simple background information to more complex, thought provoking open-ended questions concerning attitudes and perceptions. All interviews were carried out in the home language of the respondent and recorded in English.

2.11 QUALITATIVE RELIABILITY

Fortunately, small-scale farmers can recall with reasonable accuracy their broad activities and socio-economic situation over a 12 month period. Although accuracy cannot always be assured, the results of these case studies give a good indication of the overall situation on the four schemes.

Every possible precaution was taken during interviews to explain the objectives and background to the survey and questions were phrased in such a way as to avoid prejudice and bias among the respondents. Notwithstanding all these precautions, it would be too far fetched to asume that data are completely accurate throughout. However, in the writer's view the household surveys give a realistic picture of characteristics, problems, constraints and perceptions on the schemes investigated.

2.12 DATA ANALYSIS

With the presentation of these results the author wishes to point out that personal and socio-psychological characteristics can certainly not be divided into watertight compartments. Statistics are simply an aid to bringing out a complex situation and should be looked upon as providing qualitative approximations. There was a large degree of correlation between the responses by groups and similar questions put to individual heads of households, which adds further validity to the accuracy of the data.

The group interviews and irrigation scheme data were analysed by hand. Household survey data were coded and analysed by computer. Detailed statistical analysis was not considered necessary in this type of study.

CHAPTER 3

SMALL-SCALE FARMER IRRIGATION SCHEMES IN THE EASTERN CAPE, KWAZULU-NATAL AND NORTHERN PROVINCE

3.1 INTRODUCTION

As far as can be ascertained from an earlier survey (Backeberg *et al*, 1996) there were 202 small-scale farmer irrigation schemes in South Africa comprising approximately 47486ha of land under irrigation. Of these, 79% of schemes were in the Eastern Cape, KwaZulu-Natal and Northern Province. Irrigation development on the schemes in Mpumalanga province has been mainly based on establishing commercial farmers, most of which are based on sugar cane production (Bembridge, 1996).

Except for the Taung irrigation scheme, which is commercially orientated, most of the 20 schemes in North-West Province are based on vegetable growing both for food security and income (Bembridge, 1996). Small-scale farmer irrigation in the Western and Northern Cape is confined to a few small schemes in the former "reserve" areas. More recently two or three land reform schemes have been launched. In the Free State small-scale farmer irrigation is restricted to small schemes in the Qwa Qwa area, as well as a few peri-urban areas near larger towns, which are more in the nature of communal gardens (Mukhela and Groenewald, 1998).

In this chapter an overview is given of small-scale farmer schemes in the Eastern Cape and KwaZulu Natal based on information provided by field staff in agricultural departments. Unfortunately it was not always possible to obtain names of dams in the context of river catchments. Information on water reliability and the state of equipment was somewhat subjective. In the case of the Northern Province, because of lack of resources it was not possible to undertake a survey in the same detail as in the other two provinces. Data from the 1996 survey (Bembridge 1996) supplemented by information from the Agricultural Engineering Division of the Department are included as the best available information.

3.2 EASTERN CAPE PROVINCE

3.2.1 Scheme statistics

In Table 3.1 the size of scheme, number of participants, management agency and year of establishment are summarised. For purposes of classification "commercial farmers" are defined as those with plots of one or more hectares. It should be recognised that there is no clear-cut division between so called subsistence food plots and commercial farmers. It should rather be seen as a continuum from part-time subsistence to full-time commercial

farming. Foodplots can in effect become commercially orientated, if participants are keen and enthusiastic and able to manage their plots efficiently.

Table 3.1 Small-scale farmer irrigation schemes in the Eastern Cape, 1998.

Scheme	Area irrigated ha	Potential area ha	Participants*		Total	Management agency	Year established
			C F	F P H			
Ngonyameni	17,0	17,0	1	-	1	Farmers	1975
Mzomtsha	1,5	1,5	-	9	9	ECATU[1]	Not completed
Pakamisiswe	4,0	4.0	-	8	8	ECATU	1995
Orange grove	12,5	12,5	-	19	19	ECATU	Not completed
Phambili	3,5	3,5	-	5	5	ECATU	Not completed
Izikolethu	37,0	37,0	-	12	12	Border pumps	1998
Ngqubusini	3,0	3,0	-	18	18	ECATU	Not completed
Mtakatye	5,0	5,0	-	6	6	NUM[2]	1995
Mjikweni	5,3	5,3	-	10	10	Nil	1997
Vukani	4,0	4,0	-	7	7	Nil	1995
Lingelethu	0,8	1,0	-	14	14	ECATU	1998
NtsekaComm	3,0	3,0	-	15	15	E G Piping[3]	1998
Xhetfu	5,0	5,0	5	7	5	ECATU	1998
Mngazi	32,0	32,0	1	-	1	Commercial	1995
Tyefu	641,0	1200,0	32	1646	1678	Comm farmers	1983
Zanyokwe	439,0	471,0	58	146	204	Farmers	1989
Horseshoe	56,0	60,0	18	-	18	Farmers Ass.	1982
Keiskamma-hoek	744,0	744,0	45	102	147	Irrigation board	1976
Mthombe	50,0	50,0	50	-	50	Farmers	1985
Malenge	2 43,0	243,0	168	-	168	Community	N/A
Joy coemmun.	1,5	1,5	-	36	36	Committee	1986
Masizakhe	17,0	17,0	-	143	143	Committee	1994
Occupation Post	-	1200,0	-	-	-	Not developed	-
Ncora	2490,0	2490,0	16	256	272	Farmers Ass.	1979
Qamata	1959,0	1959,0	1000	-	1000	Farmers Ass.	1968
Xonxa	780,0	780,0	30	-	30	Farmers	1985
Xonxa Pilot	340,0	340,0	-	-	-	-	1985
Thornhill	27.5	27,5	-	110	110	Tribal Auth.	1983
Tendergate	100,0	100,0	-	400	400	Community	1983
Spring grove2	15,0	15,0	-	60	60	Community	1983
Spring grove1	43,0	43,0	-	172	172	Community	1983
Rocklands B	70,0	70,0	-	280	280	Community	1983
Rocklands A	18,0	18,0	-	72	72	Community	1983
Mitford	77,0	77,0	-	308	308	Man.Comm.	1983
Loudon	26,0	26,0	-	104	104	Tribal Auth.	1983
Hinana	40,0	40,0	-	160	160	Tribal Auth.	1983
Glenbrook 3	50,0	50,0	-	-	-	Tribal Farm	1983
Glenbrook 2	50,0	50,0	-	-	-	Tribal Farm	1983
Glenbrook 1	12,0	12,0	-	-	-	Tribal Farm	1983
Beccles Farm	22,0	22,0	-	-	-	Tribal Farm	1983
Yonda	16,0	16,0	-	64	64	Tribal Auth.	1984
Shiloh	455,0	455,0	15	263	278	Farmers	1970
Prices Dale 2	29,0	29,0	-	117	-	Farmers	1984
Prices Dale 1	106,5	106,5	-	213	213	Tribal Auth.	1984
Oxton Manor	60,0	60,0	-	-	-	Tribal Auth.	1984
Oxton	49,0	49,0	-	196	-	Community	1987
Ngojini	18,5	18,5	-	74	-	Farmers Ass.	1997
Mbekweni	42,0	42,0	-	84	84	Man. Comm.	1991
Haytor	19,0	19,0	-	76	76	Farmers	1984
Bushy Park	23,0	23,0	-	92	92	Man. Comm.	1984
TOTAL	**9256,6**	**11056**	**1439**	**4910**	**6349**		

*CF = Commercial farmers (>1ha) FPH = Food plot holders

[1] ECATU - Eastern Cape Appropriate Technology Unit [2] National Union of Mineworkers [3] East Griqualand Piping

3.2.2 Water supplies, energy, irrigation method and equipment

In more than half of the schemes (54%) problems of water reliability were reported (Table 3.2). this suggests that there was probably inadequate investigation of catchment yields of rivers and dams.

On two-thirds (66%) of the schemes water had to be pumped from the source, using mainly diesel fuel as a source of energy (Table 3.2). In many cases crop losses were experienced due to engine breakdowns. Only 20% of schemes were able to use electric power. With increasing ESKOM coverage in rural areas, over time some schemes will be able to switch over to electric power.

The majority of schemes used either fixed sprinkler systems or drag lines (Table 3.2). This technology is expensive and often inefficient due to underdesigned pipelines, lack of know-how by extension officers and farmers, leaks in the irrigation system, incorrect nozzles and low pump efficiency (Scott, 1998b). Provided the soils are suitable, there is merit in considering flood irrigation using the short furrow method, which will be less costly and often just as efficient as overhead irrigation (Stimie, 1996).

In 54% of schemes irrigation equipment was reported as being in poor condition, with 14% in fair condition (Table 3.2.). This further supports the general inefficiency of small-scale farmer irrigation schemes.

Fifty schemes comprising 9257ha with 6349 participants were identified in the province. In addition to the schemes listed there are 24 commercial citrus farmers in the Kat River, Tyume and Applemead area. Most of these farmers are carrying a high debt load mainly on account of poor financial management.

Thirteen new small-scale schemes have been implemented in the last four years. These are managed by the parastatal Eastern Cape Appropriate Technology Unit (ECATU) as well as the private sector (Table 3.1), with most operations undertaken by the farmers themselves.

Most of the larger schemes including Tyefu, Zanyokwe, Keiskammahoek, Ncora and Shilo were initially managed by consultants, and later by Agricultural Development Corporations (ULIMOCOR and TRACOR) on behalf of the Department of Agriculture. The recent withdrawal from management of these schemes by the Department of Agriculture, and the changing scenario in government financed irrigation schemes in the past four years due to shortage of funding, has resulted in deterioration of the physical structures, and in some cases, theft of equipment. Ncora, Tyefu, Shilo and Keiskammahoek have almost completely collapsed. This situation has led to low yields and a drastic drop in household incomes.

Table 3.2 Water source, water reliability, reticulation, energy source, irrigation method, state of equipment and infrastructure, Eastern Cape small-scale farmer irrigation schemes, 1998.

Scheme	Water source	Water reliability*	Reticulation system	Energy source	Infrastructure	State of Equipment
Ngonyameni	Umtata River	Good	Pumping	Diesel	Sprinklers	Good
Mzoentsha	River	Fair	Pumping	Diesel	Not implemented	
Pakamisiswe	River	Good	Pumping	Diesel	Sprinkler/drag	Good
Orange Grove	River	Good	Pumping	Diesel	Not implemented	
Phambili	Mabetshe River	Good	Not implemented			
Izikolethu	River	Good	Pumping	Electricity	Sprinkler/drag	Good
Ngqubusini	River	Good	Pumping	Diesel	Not implemented	
Matakatye	Matakatye River	Good	Pumping	Diesel	Sprinkler/drag	Good
Mjikweni	Tsitsa River	Good	Pumping	Diesel	Sprinkler	Good
Vukani	River	Good	Pumping	Diesel	Sprinkler/drag	Good
Lingelethu	Dam	Fair	Pumping	Diesel	Drag lines	Good
Ntsaka Comm.	Umtata River	Good	Pumping	Diesel	Drag lines	Good
Xhefu	River	Good	Pumping	Diesel	Sprinkler/drag	Good
Mngazi	Umngazi River	Good	Pumping	Diesel	Sprinklers	Good
Tyefu	Fish River	Good	Pumping	Electricity	Sprinkler/drag	Fair
Zanyokwe	Sandile Dam	Good	Gravity	Electricity	Sprinkler	Fair
Horseshoe	Buffalo River	Good	Pumping	Electricity	Sprinklers	Poor
Keiskammahoek	Cota Dam	Good	Gravity	-	Sprinkler	Poor
Mthombe	Keiskamma River	Good	Pumping	Diesel	Sprinklers	Poor
Malenge	River	Fair	Gravity	-	Flood	Poor
Joy Community	Borehole	Fair	Pumping	Electricity	Flood	N/A
Manzakhe	Fish River	Fair	Pumping	Electricity	Sprinkler/drag	Fair
Occupation Post	Xonxa Dam	Good	Pumping	Diesel	Sprinklers	Poor
Ncora	Ncora Dam	Good	Gravity	-	Sprinkler/drag	Poor
Qamata	Lubisi Dam	Good	Gravity	-	Flood/sprinkler	Poor
Xonxa	Xonxa Dam	Good	Pumping	Electricity	Centre pivot	Poor
Xonxa Pilot	Xonxa Dam	Good	Pumping	Diesel	Sprinklers	Fair
Thornhill	Swart Kei River	Poor	Gravity /pump	Diesel	Sprinkler/drag	Poor
Tendergate	Dam	Poor	Gravity	-	Flood	Poor
Spring Grove 2	Dam	Poor	Pump/gravity	Diesel	Sprinkler	Poor
Spring Grove 1	Dam	Poor	Pump/gravity	Diesel	Sprinkler/drag	Poor
Rocklands B	Swart Kei River	Poor	Pump/gravity	Diesel	Sprinkler/drag	Poor
Rocklands A	Swart Kei River	Poor	Pump/gravity	Diesel	Sprinkler/drag	Poor
Mitford	Dam	Poor	Gravity/pump	Diesel	Sprinkler/drag	Poor
Loudon	Borehole	Poor	Pumping	Diesel	Sprinkler/drag	Poor
Hinana	Swart Kei River	Poor	Pumping	Diesel	Sprinkler/drag	Poor
Glenbrook 3	Dam	Poor	Gravity	Diesel	Sprinklers	Poor
Glenbrook 2	Dam	Poor	Gravity	Diesel	Sprinklers	Poor
Glenbrook 1	Dam	Poor	Gravity	-	Flood	Poor
Beccles Farm	River B Hs	Poor	Pumping	Diesel	Sprinklers	Poor
Yonda	Dam	Fair	Gravity	-	Drag line	Fair
Shiloh	Dam/River	Fair	Gravity	Electricity	Cpivot/sprinkler	Poor
Prices Dale 2	Dam/River	Fair	Gravity	-	Sprinkler/drag	Poor
Prices Dale 1	Dam/river	Fair	Gravity	Diesel	Sprinkler	Poor
Oxton Manor	Dam/River	Fair	Gravity	-	Sprinkler	Poor
Oxton	Dam/River	Fair	Gravity	-	Sprinkler	Poor
Ngojini	Ordraal Dam	Good	Pumping	Electricity	Sprinkler	Poor
Mbekweni	Dam/River	Fair	Gravity	-	Sprinklers	Fair
Haytor	Dam/River	Fair	Pumping	Electricity	Sprinkler/drag	Fair
Bushy Park	Dam/river	Fair	Pumping	Diesel	Sprinkler/drag	Poor

*Good = reliable water supply; Fair = Occasional season shortages; Poor = unreliable in drought years

3.2.3 Land Tenure, Soils and Crop Production

3.2.3.1 Land tenure

Land tenure is both an emotional issue and very much a political matter. Whatever the system of land tenure, it is generally agreed that productivity per hectare is likely to be higher on small-scale holdings when there is security of tenure (Ward, 1979). With due regard to present pressures on the land, land reform should ideally be designed to support a small-holder class of farmer.

The main legal form of land ownership is"communal" and is known as *Certificate of Occupation* in the Eastern Cape and *Permission to Occupy* in Natal (Table 3.3) This implies that the land is owned by the nation or the tribal authority and the land is allocated to an individual and cannot be sub-divided, consolidated or sold. Inheritance is *de facto* if not *de jure*, and is assumed and prescribed by traditional succession. Furthermore, land cannot be used as security for loans of debts. The individual is assured of possession of the land for life, provided he/she uses the land (not necessarily productively), pays taxes and is law abiding (Southey, 1981). Share cropping and hiring of land from those unable or unwilling to use their land is practised informally on a number of irrigation schemes.

Current proposals on land reform in South Africa tend to leave it to communities to decide on the most suitable land tenure system to suit their purposes. The need for land reform is supported by a number of findings which show that small-scale farmers aspire to acquiring more land. Probably more in keeping with the present tenure system is a system of negotiable rights administered by local authorities. Under this system, the right holders' rights would be registered and negotiable. The impact of land reform *per se* on agricultural production depends largely on other institutional reforms, such as water policy, infrastructure, credit, marketing, research, and extension (Cohen, Goldsmith and Mellor, 1976).

3.2.3.2 Soils

Unlike the situation concerning reliability of water supplies, it appears that soil selection for irrigation schemes was generally good. In only 26% of schemes were soils reported to be "fair" indicating some soil constraints (Table 3.3).

3.2.3.3 Crops and crop yields

Crops produced, and soil rating on each scheme, as well as a subjective assessment by agricultural department officials of the percentage of individual farmers falling within a scale of 1 - 5 from very poor (1) to excellent (5) are shown in Table 3.3.

Table 3.3 Land tenure, soil rating, major crops and crop yield rating, Eastern Cape small-scale farmer irrigation schemes, 1998.

Scheme	Land tenure	Soil rating***	Major crops*	Crop yield category %**				
				5	4	3	2	1
Ngonyameni	Communal	Good	T,M,C,Ca,S	40	60	-	-	-
Mzontsha	Communal	Good	V	30	30	40	-	-
Pakamisiswe	Leasehold	Good	Ca,S,Fr	30	60	10	-	-
Orange Grove	Communal	Good	V	30	50	20	-	-
Phambuli	Communal	Good	V,M	40	50	10	-	-
Izikolethu	Communal	Good	C,Ca,S,M	50	20	30	-	-
Mgqubusini	Communal	Good	V	40	60	-	-	-
Mtakatye	Communal	Good	V,M	40	60	-	-	-
Mjikweni	Communal	Good	V	40	50	10	-	-
Vukani	Communal	Good	C,P,C,S	50	30	20	-	-
Lingelethu	Communal	Fair	V	40	50	10	-	-
Ntseka Comm.	Communal	Good	V	60	40	-	-	-
Xhefu	Communal	Good	C,P,C	30	50	20	-	-
Mngazi	Communal	Good	V	60	40	-	-	-
Tyefu	Communal	Fair	V,M,C		Not	operational		
Zanyokwe	Lease/title	Good	V,M	10	40	50	-	-
Horsenshoe	Communal	Good	V,M	10	60	30	-	-
Keiskammahoek	Lease/title	Good	V	-	-	10	30	60
Mthombe	Communal	Good	V,M	-	-	5	75	20
Malenge	Communal	Good	M,P,B,Ca	-	5	15	50	30
Joy Community	Leasehold	Fair	Be,C,Ca,O,T	20	15	55	5	5
Masizakhe	Title	Good	P,Ca,Be,S,P	-	15	50	25	10
Occupation Post	State land	Good			Not	operational		
Ncora	Leasehold	Good	M,B,Ca,P	10	30	40	15	5
Qamata	Communal	Fair	M,Ca,P,L,P,W	-	25	25	25	25
Xonxa	Communal	Fair	M,Ca		Not	operational		
Xonxa Pilot	Communal	Fair			Not	operational		
Thornhill	Communal	Fair	M,Pu,P,B,O		Not	operational		
Tendergate	Communal	Good	M,Pu,P	-	-	-	-	100
Spring grove 2	Communal	Good	M,Pu,P	-	-	-	-	100
Spring Grove 1	Communal	Good	M,Pu,P	-	-	-	-	100
Rocklands B	Communal	Good	M,Pu	-	-	-	-	100
Rocklands A	Communal	Good	M,Pu,P	-	-	-	-	100
Mitford	Communal	Good	M,B,W	-	-	-	-	100
Loudon	Communal	Good	M,P,B,O	-	-	-	-	100
Hinana	Communal	Fair	M,Pu,P,B,O	-	-	-	-	100
Glenbrook 3	Communal	Good	M,P,B	-	-	-	-	100
Glenbrook 2	Communal	Good	M,P,Pu,B	-	-	-	-	100
Glenbrook 1	Communal	Good	F,Pu,P,C	40	30	30	-	-
Beccles Farm	Tribal	Good	M,P,Pu,C,T	-	-	-	-	100
Yonda	Communal	Fair	M,Pu,B,W,P	-	10	85	5	-
Shiloh	Leasehold	Fair	M,C,P,C,Be	-	-	-	80	20
Prices Dale 2	Communal	Fair	M,Pu,B,W	-	10	80	10	-
Prices Dale 1	Communal	Good	M,Pu,B,W	-	5	75	20	-
*Oxton Manor	Communal	Good	M,P,W,C,P	-	15	65	20	-
Oxton	Communal	Good	M,Pu,B,W,P	-	5	80	15	-
Ngojini	Communal	Fair	M,C,P,L,B	-	-	70	30	-
Mbekweni	Communal	Good	M,Pu, B,W	-	15	75	10	-
Haytor	Communal	Fair	M,Pu,B,P	-	5	85	10	-
Bushy Park	Communal	Fair	M,Pu,W	-	-	-	90	10

* Crops B=Beans, Be= Beetroot, C=Carrots, Ca=Cabbage, F=Fruit, L=Lucerne, M=Maize, O=Onions, P=Potatoes, Pa= Pasture, Pu=Pumpkins, S=spinach, T=tomatoes, V=General vegetables, W=Wheat.

** Individual crop yield assessment : 5 = excellent, 4 = very good, 3 = fair, 2 = poor, 1 = very poor.
*** Good - High potential. Fair - Moderate potential as per extension worker assessment

Generally speaking maize and vegetables were the most important staple food crops grown on small-scale farmer irrigation schemes. Cash crops included cabbage, onions, potatoes, spinach, tomatoes, beans, and wheat (Table 3.3).

Crop yields were extremely variable. On the newer established small schemes, yields were reported to be reasonably good, while on similar old established schemes yields were extremely poor. On the larger schemes, yields were generally poor for the reasons given in 3.2.2 above.

3.2.4 Problem perception

Table 3.4 gives an assessment by agricultural staff of major problems experienced on irrigation schemes according to size of scheme. Chapters 4 to 7 refer to perceptions of scheme participants. Understandably due to withdrawal of management on the large schemes, poor maintenance and lack of farmer training were perceived as the most important problems. Associated problems were various forms of local and political conflict, high running costs, lack of credit and markets, the poor state of scheme fencing, poor access roads, theft and water quality. Weak local organisations were also mentioned.

Table 3.4 Rank order of comments on scheme problems according to size of scheme, Eastern Cape small-scale irrigation schemes, 1998.

SCHEME SIZE CATEGORY		
< 20 ha	**20 - 50 ha**	**> 50 ha**
1. Lack of fencing	1. Local and political conflict	1. Poor maintenance of infrastructure/equipment
2. Local and political conflict	2. Poor maintenance of infrastructure/ equipment	2. Lack of farmer training
3. Theft	3. Theft	3. Local and political conflict
4. Poor maintenance of infrastructure/ equipment	4. Lack of fencing	4. High pumping costs
5. Lack of farmer training	5. Lack of credit	5. Lack of credit
6. Lack of credit	6. Poor records	6. Poor markets
7. Lack of markets	7. Lack of farmer training	7. Lack of fencing
8. Fair to poor soils	8. Lack of draught power	8. Poor access roads
9. Water shortages		9. Theft
		10. Water salinity
		11. Soil salinity
		12. Weak local organisations

On the small-schemes, lack of adequate fencing resulting in damage by animals, local and political conflict, theft of crops and poor maintenance of infrastructure and equipment were cited as major problems. Other problems mentioned were similar to the larger schemes (Table 3.4).

On medium sized schemes (20 - 50ha), the same problems as perceived on small-schemes were also cited as the top four problems. Of significance was that in all categories, poor maintenance of infrastructure and equipment, as well as local and political conflicts were

seen as the most important problem areas. The latter is often due to conflict between traditional leaders and new structures, causing instability in local leadership.

3.2.5 Rehabilitation needs

Agricultural department officials were asked to assess the needs to rehabilitate individual schemes. Responses in rank order according to scheme size are given in Table 3.5

Table 3.5 Rank order of scheme rehabilitation needs according to size of scheme, Eastern Cape small-scale farmer irrigation schemes, 1998.

SCHEME SIZE CATEGORY		
<20 ha	**20 - 50ha**	**> 50 ha**
1. Upgrade infrastructure	1. Upgrade infrastructure	1. Upgrade infrastructure
2. Farmer training /extension	2. Conflict resolution	2. Farmer training
3. Upgrade fencing	3. Improved fencing	3. Improved participation
4. Improved energy sources	4. Upgrade equipment	4. Resolve conflicts
5. Upgrade equipment	5. Solve theft problems	5. Train extension workers
6. Conflict resolution	6. Farmer training	6. Upgrade equipment
7. Farmer participation	7. Improve access roads	7. Upgrade fencing
8. Extension officer training		8. Security of tenure
9. Farm inputs		9. Improved markets

Understandably the need to upgrade infrastructure and equipment, and resolve conflicts were major needs on the medium and large projects (Table 3.5). Farmer training and improved training of extension officers were cited as major needs on the larger schemes. Security of tenure and improved markets were also mentioned as important needs on the larger schemes.

The need to upgrade infrastructure and equipment, including fencing were cited as important needs on the small schemes. The need for an improved energy source centres around replacing diesel engines with electricity. Farmer and extension officer training, provision of farm inputs and greater farmer participation were also mentioned as important rehabilitation needs (Table 3.5).

3.3 KWAZULU-NATAL

3.3.1 Scheme statistics

In KwaZulu-Natal there are some 17 small-scale farmer irrigation schemes, comprising 6388ha and involving 5856 households, mainly foodplots. The Makhatini scheme is the largest in the province and has an estimated irrigation potential from the Jozini Dam of between 12 000ha and 25000ha. Other than Makhatini which has recently partially switched from cotton to sugar cane as the most important crop, the other "commercial farmer" schemes are based mainly on sugar cane production which has a ready market and good support services (Table 3.6 and 3.8).

Tongaat Hulett Sugar Company and Illovo Sugar are responsible for support services on a contract basis to farmer management committees of three and five of the sugar cane schemes respectively. The Makhatini scheme is managed by Mjindi Farming Company. Most of the other schemes are managed by the KwaZulu-Natal Department of Agriculture (KDA) (Table 3.6).

Table 3.6 Small-scale farmer irrigation schemes in Kwazulu-Natal, 1998

Scheme	Area irrigated ha	potential area ha	PARTICIPANTS*			Man .agency	Year estab.
			C. Fs	F.P.Hs	Total		
Buhulwane	350	350	-	430	430	K D A[1]	1967
Mzondeni	167	167	43	-	43	Illovo	1994
Ndumu B	150	350	11	-	11	KDA/KFC[2]	1993
KwaDlama	167	200	43	-	43	Tongaat/Hulett	1991
Biyela	501	501	277	-	277	Tongaat/Hulett	1991
Ngwelezana	16	21	-	105	105	KDA	1975
Mzimela	338	338	125	-	125	Tongaat/Hulett	1995
Mkuphula	20	45	-	244	244	KDA	1988
Mooi River	340	390	-	760	760	KDA	-
Tugela Ferry	540	640	-	1832	1832	KDA	-
Mansomeni	186	236	63	-	63	Illovo sugar	1983
Sinamfini	272	272	-	176	176	Illovo sugar	1988
Shinga	20	20	20	-	20	Lima R F	-
DakaDaka	234	234	160	-	160	Illovo sugar	1994
Mthandeni	93	93	33	-	33	Illovo sugar	1978
Thukela Est.	374	474	-	1275	1275	KDA	1969
Makhatini	2620	12000	259	-	259	Mjindi Coy.	1985
Total	**6388**	**17064**	**1034**	**4822**	**5856**		

* CFs = Commercial Farmers. FPHs = food plot holders
[1] KDA = Kwa Zulu Natal Department of Agriculture [2] KFC = KwaZulu finance corporation

3.3.2 Water suppplies, energy, irrigation method and equipment

In most cases the reliability of water supplies does not pose a problem. Practically all schemes involved pumping from dams or rivers. Only 24% are gravity fed schemes. Two-thirds use electricity as a source of energy. The majority of schemes (70%) use some form of sprinkler or overhead irrigation and the remainder use flood irrigation (Table 3.7).

Table 3.7 Water source, water reliability, reticulation, energy source, irrigation method, state of infrastructure and equipment, KwaZulu-Natal small-scale farmer irrigation schemes, 1998.

Scheme	Water source	Water reliability	Reticulation system	Energy source	Irrigation method	State of equipment infrastructure
Bululwane	Bululwane River	Fair/Good	Gravity	-	Flood	Fair/Poor
Ndumu B	Pongola River	Good	Pumping	Electricity	Sprinkler	Fair
Mzondeni	Umfolozi River	Good	Pumping	Electricity	Sprinkler	Good
KwaDlama	River	Good	Pumping	Electricity	Sprinkler	Fair
Biyela	Mhlatuze River	Fair	Pumping	Electricity	Sprinkler	Fair
Ngwelezana	Dam	Good	Pumping	Diesel	-	Poor
Nzimela	River	Fair	Pumping	Electricity	Sprinkler	Fair
Mkuphula	Mooi River	Good	Pumping	Diesel	Flood	Good
Mooi River	Mooi River	Good	Gravity	Diesel	Flood	Good
Thukela Ferry	Thukela River	Good	Pump/Gravity	Electricity	Flood	Fair
Mansomeni	Umvoti River	Good	Pumping	Electricity	Sprinkler	Fair
Sinamfini	Umvoti River	Good	Pumping	Electricity	Sprinkler	Fair
Shinga	Umzombi River	Good	Pumping	Electricity	Sprinkler	Fair
DakaDaka	Umvoti River	Good	Pumping	Electricity	Sprinkler	Good
Mthandeni	River	Good	Gravity	-	Flood	Good
Thukela Estates	Thukela River	Good	Gravity/pump	Electricity	Sprinkler/flood	Poor
Makhatini	Dam	Good	Gravity/pump	Electricity	Sprinkler	Fair

3.3.3 Land tenure, soils and crop production

3.3.3.1 Land tenure

All the schemes are held by the traditional communal form of tenure which was described in 3.2.3.1 above (Table 3.8)

Table 3.8 Land tenure, soil rating, major crops and crop yield rating, KwaZulu/Natal small-scale farmer irrigation schemes, 1998

Scheme	Land tenure	Soil rating	Major crops	Crop yield category				
				5	4	3	2	1
Bululwane	Communal	Fair/good	Ca,T,O,M,B	-	30	20	20	30
Ndumu B	Communal	Good	Co,M,V,B,S,C	-	10	34	56	-
Mzonsleni	Communal	Good	SC	25	45	23	7	-
KwaDlama	Communal	Good	SC	30	23	20	15	12
Biyela	Communal	Fair	SC	23	21	21	15	20
Ngwelezana	Communal	Fair	V,M,B	29	24	20	15	12
Nzimele	Communal	Good	SC	30	22	15	21	12
Mkuphula	Communal	Good	Ca,M,T,P,B	10	30	40	10	10
Mooi River	Communal	Good	M,P,B,T,Ca	10	30	40	15	5
Tugela Ferry	Communal	Good	M,T,P,Ca,O	10	30	40	15	5
Mansomeni	Communal	Good	SC,M,V	15	35	30	15	5
Sinamfini	Communal	Good	SC,M,V	25	25	40	5	5
Shinga	Communal	Good	M,P,V	-	-	-	-	-
DakaDaka	Communal	Good	SC	25	25	40	5	5
Mthandeni	Communal	Fair	SC	20	30	40	7	3
Thukela Estates	Communal	Good	M,W,C,B,T,V	-	6	8	4	82
Makhatini	Communal	Good	SC,Co,M,W,V	-	25	25	36	14

*Crops B=Beans, Ca = Cabbage, Co=Cotton, M = Maize, O = Onions, P = Potatoes, S = Spinach, SC = Sugar Cane, T = Tomatoes, V = Vegetables - general, W = Wheat,

** Individual crop yield assessment : 5 = excellent, 4 = very good, 3 = fair, 2 = poor, 1 = very poor

3.3.3.2 Soils

With three exceptions, there were no soil limitations. Schemes were generally sited on good irrigable soils (Table 3.8).

3.3.3.3 Crops and crop yields

Forty one per cent of schemes were based on sugar cane production which has a ready market. On the other schemes a wide range of crops were grown. Maize was invariably the main staple food crop. Other crops included cabbages, tomatoes, onions, beans, potatoes, spinach, wheat and vegetables in general (Table 3.8).

Crop yields on the sugar schemes were reasonable, although there were a number of individual farmers with poor management, especially inadequate weed control. On other schemes yields were variable due to lack of resources, including inputs and credit, as well as managerial problems (Table 3.8)

3.3.4 Problem perception

On sugar cane schemes Department of Agriculture staff perceived poor access roads, inadequate fencing of schemes resulting in damage by livestock, shortage of harvesting

contractors, poor maintenance of infrastructure and inadequate soil conservation works as major problems.

On the other schemes poor maintenance of infrastructure and equipment was cited as the most important problem. Other problems included poor fencing maintenance, the need to level irrigation beds, inadequate draught power, poor marketing outlets and the need for electricity to replace diesel fuel as an energy source.

3.3.5 Rehabilitation needs

On the sugar schemes, improved access roads was perceived as the most important need. On other schemes, upgrading infrastructure and equipment was the most important need mentioned. Other needs were for improved fencing of schemes, debt repayment, improved markets, farmer and extension officer training, as well as provision of credit facilities for inputs.

3.4 NORTHERN PROVINCE

3.4.1 Introduction

As mentioned in 3.1 it was not possible to obtain up-to-date information on small-scale farmer irrigation schemes in the Northern Province. Recently a survey of the Thabina, Metz, Madeira, Grootfontein, Koedoeskop, Boschkloof, Mutale, Morgan and Capes Thorn irrigation schemes was commissioned by the Department of Agriculture and undertaken by Stewart Scott Inc. (1998). What follows is a general, but incomplete, description of the majority of irrigation schemes based on the less detailed 1996 survey (Bembridge, 1996) supplemented by information from a series of workshops conducted by the Department of Agriculture during 1997, as well as information from a survey conducted by Stewart Scott Inc. on behalf of the Department in 1998.

Issues of land tenure, problems and rehabilitation needs mentioned in the Eastern Cape and KwaZulu Natal, also have application for irrigation schemes in the Northern Province.

3.4.2 Irrigation scheme statistics

The Department of Agriculture identified 167 irrigation schemes in the Province, 54 of which were apparently not settled by individual small-scale farmers (Northern Province, Department of Agriculture, 1998). Table 3.9 lists 117 schemes currently identified as having been settled by individual small-scale farmers. These schemes comprised a total of 19 291 hectares with 10 150 farmers participating, of whom 1 717 had irrigation plot allocations of less than 1ha. There were two schemes, namely Sepitise (24 farmers) and Majege (13 farmers) for which no information was available. There was reason to suggest that the data supplied by the Department of Agriculture may not be accurate throughout. This was due to problems of staff shortages within the Department.

Table 3.9 Small-scale irrigation schemes in the Northern Province

SCHEME	WATER SOURCE	COMMODI-TIES	AREA IRRIGATED ha	NO. FARMERS	NO. & TYPE OF UNIT		
					NO. FOOD PLOTS<1ha	COMMER-CIAL NO.	OTHER
Tshaulu	River	Maize, veges. ground nuts	35	36	-	36	
Lambani	Levuvhu River	Cash crops	36	111	111	-	
Tshimbopfe	Levuvhu River	Veges.	12	17	-	17	
Tshikonelo	River	Veges.	75	52	48	4	
Malavuwe	Mutshindidi River	Veges.	22	24	-	24	
Mangondi	Levuvhu River	Veges.	17	63	63	-	
Paswane	Mutshunduđi River	Fruit	200	20	-	20	
Maizvulu	Mutshunduđi River	Veges.	20	24	-	24	
Mhingu - Xikundu	River	Fruit, cash crops	150	22	-	22	
Grootfontein	Tungwane River	Maize, wheat, cotton, veges.	110	58	-	58	
Coetzeesdraai	Arabie Dam	Maize, wheat	118	98	-	98	co-op farm
Dingleydale	Tshulandziteka River	Maize, veges.	937	700	-	700	
Phadzima	Tshihuladi River	Maize, ground nuts	82	64	-	64	
Beaconsfield	Mutshedzi River	Maize, beans	38	24	-	24	
Mandiwana	Nzhelele river	Beans, tomatoes	67	52	-	52	
Rabali	Nzhelele River	Maize, tomatoes	87	68	-	68	
Capen Thorn	Manaledzi River	onions, maize, beans	99	77	-	77	
Mphaila	Mutshedzi River	Onions, maize	71	57	-	57	
Garside	Lomadi River	Tomatoes, maize, pumpkins	52	44	-	44	
Diepkloof	Tshanzhe River	Tomatoes, maize, beans	40	27	-	27	
Cordon	Mutshedzi River	Tomatoes, maize,beans	81	52	-	52	
Mamulhohi	Nzhelele River	Maize, beans	77	59	-	59	
Mphephu	Nzhelele river	Maize, tomatoes, groundnuts	112	87	-	87	
Homu	Middle Letaba River	Bananas	180	15	-	15	
Salwane	Letaba River	Citrus, mangoes	59	9	-	9	-
Olifants river	Olifants River	Maize, wheat	2200	850	-	850	-
Phaswana	Mutshindi River	Bananas	269	17	-	17	
Saringua	Sabi River	Citrus, mangoes	220	30	-	30	Service centre
Mariveni	Letaba River	Citrus, bananas	300	22	-	22	-

Table 3.9 (continued)

Hozane	Sabi River	Veges, maize, fruit	656	64	-	64	-
Dumfries	Edenburg Dam	Maize, wheat, veges.	25	7	-	7	-
Mwanedzi	Mwanedzi Dam	Tomatoes	800	100	-	100	-
Tswelopele	Olifants River	Cotton, paprika	465	31	-	31	-
Middle Letaba	Middle Letaba Dam	Veges. tomatoes	1400	120	-	120	+ 1000 ha API + CDC
Tshiombo	Mutalio River	Veges., maize	1000	300	-	300	-
New Forest	Orinoco Dam	Tobacco	548	423	-	423	-
Mabundu	Nondweni River	Cash crops	300	20	-	20	-
Sekororo Metz	Rivers	Veges., fruit	118	118	-	118	-
Hindustan	Buffelsdoring Dam	Maize, wheat, veges.	52	43	-	43	-
Veeplaats	Piet Gouws Dam	Maize, wheat, cotton	360	360	-	360	-
Haakdoring-draai	Olifants River	Maize, wheat	102	76	-	76	-
Wonderboom	Olifants River	Maize ,wheat	113	88	-	88	-
Nooitgesien	Olifants River	Maize, wheat	73	73	-	73	-
Krokodil	Olifants River	Maize, wheat	240	240	-	240	-
Vlakspruit	Dam	Maize, wheat	120	51	-	51	-
Brakfontein	Olifants River	Maize, wheat, cotton	13	13	-	13	-
Vlakplaas	Arabie Dam	Maize, wheat	74	62	-	62	-
Volstruiskop-pies	Arabie Dam	Maize, wheat	123	96	-	96	-
Gataan	Arabie Dam	Maize, wheat	163	127	-	127	-
De Paarl	Arabie Dam	Maize, wheat	64	50	-	50	-
Platklip	Dam	Maize, veges.	144	120	-	120	-
Montevideo	River	Maize	108	90	-	90	-
Dewerani	Levubu River	Cash crops	26	113	117	-	-
Nesengani B1	Levubu River	Cash crops	26	100	100		-
Nesengani B2	Levubu River	Cash crops	41	161	161		-
Nesengani	Levubu River	Cash crops	17	33	33		-
Nesengani C	Levubu River	Cash crops	31	162	162	-	-
Khumbe	Dzando River	Cash crops	145	111	-	111	-
Tshiombo 2A	Mutale River	Maize, veges.	74	62	-	62	-
Tshiombo 1A	Mutale River	Maize, veges.	128	98	-	98	-
Tshiombo 4C	Mutale River	Maize, veges.	113	78	-	78	-
Tshiombo 3A	Mutale River	Maize, veges.	174	100	-	100	-
Tshiombo 4A	Mutale River	Maize ,veges.	86	59	-	59	-
Tshiombo 4B	Mutale River	Maize, veges.	111	87	-	87	-
Tshiombo 2	Mutale River	Maize, veges.	123	82	-	82	-

Table 3.9 (continued)

Tshiombo 4	Mutale River	Maize, veges.	53	41	-	41	-
Tshiombo 2B	Mutale River	Maize, veges.	78	61	-	61	-
Tshiombo 1	Mutale River	Maize, veges.	61	44	-	44	-
Tshiombo 1B	Mutale River	Maize, veges.	108	80	-	80	-
Tshiombo 3	Mutale River	Maize,veges.	100	50	-	50	-
Sanan	Mutale River	Maize, veges.	39	8	-	8	-
Dzindi	Dzindi River	Maize, veges.	136	106	-	106	-
Palmaryville	Latashe River	Maize, groundnuts	93	64	-	64	-
Dopeni	Nzhelele River	Maize, veges.	170	132	-	132	-
Murara	Tshinane River	Maize, veges	37	29	-	29	-
Folovhodwe	Rupheple River	Maize, veges.	59	117	117	-	-
Klein Tshipise	Spring	Maize, groundnuts	9	30	-	30	-
Mutale	Mutale River	Maize, veges.	33	7	-	7	-
Rambuda	Tshala River	Maize, veges. groundnuts	34	102	102	-	-
Sekgopo	Borehole	-	210	30	-	30	-
Rembander/ Khumbe	Ozondo River	maize, veges. groundnuts	145	224	224	-	-
Sanari	Mutale River	maize, veges. groundnuts	39	5	-	5	-
Mamushoki	Motshedzi River	maize, veges. groundnuts	37	59	59	-	-
Brakfontein	Olifants River	maize, veges.	13	12	-	12	-
Gompies	Borehole	vegetables	115	46	-	46	-
Elandskraal	Olifants River	maize, wheat	143	61	-	61	-
Goedver-trouend	Olifants River	maize, wheat	123	102	-	102	-
Sterkspruit	Sterkspruit River	maize, veges. groundnuts	436	200	-	200	-
Goedver-wacht	Olifants River	cotton, wheat	90	30	-	30	-
Varschwater	-	maize,wheat	16	14	-	14	-
Mooiplaats	Olifants River	maize, wheat	104	85	-	85	-
Canyon	Mohlapetsi River	maize, veges.	3	3	-	3	-
Firtilties	Mohlapetsi River	maize, veges.	96	72	-	72	-
Haflendon Heights	Mohlapetsi River	maize, veges.	35	35	-	35	-
Koedoeskop	Malepies River	sorghum	50	97	97	-	-
Lepellane	Lapellane River	Maize, wheat, cotton	340	340	-	340	-
Mecklenburg	Motse River	maize, veges.	65	50	-	50	-
Rietfontein	Kgoroeg River	maize, veges.	50	50	-	50	-
Steelpoort Drift	Shakwaneng River	maize veges.	72	72	72	-	-
Strydkraal	Olifants River	maize, wheat	243	200	-	200	-

Table 3.9 (continued)

Success	Tongwana River	maize, wheat	116	97	97	97	-
Vallies	Stream	maize, veges.	29	25	-	25	-
Boschkloof	Steelpoort River	Maize, veges.	320	26	-	26	-
Lucern	Stream	maize, wheat	48	40	-	40	
Zeekoiegat	Makgalakwena R.	-	25	30	30	-	-
Sekgakga-peng	Makgalakwena R.	Maize, wheat soya,sunflower	28	14	-	14	-
Mapela	Sandsloot River	maize, veges, sweet potato	96	83	-	83	-
Tshimbopfe	Levuvhu River	-	12	17	17	-	-
Tshikonelo	-	-	75	52	-	52	-
Dopeni	Zzhelele River	Maize, veges. groundnuts	107	132	132	-	-
Mandiwana	Mutshedzi River	-	67	132	132	-	-
Krokodil-heuwel	Olifants River	Wheat,maize	64	50	-	50	-
Tzwelopele	Steelpoort River	Wheat, maize, sorghum	407	31	-	31	-
Koedoeskop	Malies River	Sorghum	116	97	-	97	-
Thabina	Thabina River	Maize, fruit, veges.	288	124	-	124	-
Madeira	Moungwane River	Fruit, veges.	138	130	-	130	-
Morgan	Levuvhu River	Tomatoes, veges. maize	75	24	-	24	
		TOTAL	19291	10150	1717	8433	

Veges.= vegetables

Results of a series of workshops held in each of the six regions of the Northern Province during 1997 (Northern Province Department of Agriculture, 1997) revealed the following generalisations on problems related to small-scale farmer irrigation schemes in the Province :-

- Management by Government and para-statals was generally of a "top down" nature with little farmer involvement.
- Many of the schemes are poorly maintained and in varying states of disrepair, while others require reassessment and redevelopment.
- Average holdings vary between 1 and 3ha, and are based mainly on provision of food security.
- While many farmers have some experience of irrigation, they still lack adequate knowledge of cropping practices and irrigation techniques with resultant low yields.
- Many small-scale farmer irrigation schemes are run by women and pensioners who have certain resource and physical constraints.

- The needs and limitations of women are not adequately catered for and many lack management skills.

- Many schemes are poorly served by access roads, and transport services are inadequate, resulting in poor access to markets.

- There was a general lack of marketing opportunities.

- Water availability at peak periods is a constraint on many schemes.

- Water management and usage efficiency is well below optimum and there is evidence of over-irrigation.

- Crop production technology, especially fertilizer usage, is well below potential.

- Inadequate mechanisation back-up is a major constraint.

- On some schemes, organised marketing of cash crops has led to a large degree of regimentation in cropping programmes, as well as low returns to farmers.

- The present land tenure system is considered a constraint and is usually vested in males.

- Only a small percentage of an estimated 3000 community gardens are deemed to have been successful

Important suggestions on rehabilitation of irrigation schemes which were put forward in the workshops included:-

- There was a need for farmer education and training in all aspects of irrigation.

- There was a need for subsidies in order to upgrade present flood schemes to more modern sprinkler and drip irrigation systems.

- There was a need for better trained management and control on irrigation schemes.

- There was a need to pay more attention to the needs of women on irrigation schemes.

- There was a need for improved access to credit and the establishment of agro-industries on larger schemes.

- It was considered that for schemes to become economically viable, farmers should play a much greater role in management.

- There was a need for land reform with individual title deeds.
- Infrastructure should permit independent development of plots by entrepreneur farmers, as well as voluntary sub-division of plots into smaller areas to cater for women and older men.
- A clear policy for water allocations should be developed.
- Ways and means of identifying sustainable schemes should be given high priority
- There is a need for more appropriate design standards in close liaison with research and the industry.
- There was a need to strike the right balance between irrigation and agronomic factors.
- Upgrading of irrigation schemes should be undertaken in close co-operation with the farmers to ensure that their needs were fulfilled.
- There was a need to assess the upgrading of infrastructure and water management according to the merits of each individual scheme.

What follows is a discussion on individual schemes based on the 1996 survey (Bembridge, 1996),as well as the findings of Stewart Scott Inc. (1998).

A major problem on the Tshaulu scheme was that many farmers lived away from the scheme. Only about one in four farmers are producing at reasonable levels. A similar situation pertains on the Lambeni community project where only 27 per cent of participants were assessed as achieving reasonable levels of production. High fuel costs and lack of inputs were also cited as a problem on the latter project . Lack of finance for inputs is cited as a problem on the Tshimbopfe scheme. A similar problem occurs on the Tshikanelo food plot scheme where only one in four farmers has a reasonable level of production - others are apparently not motivated to improve production levels.

Only 38% of participants in the Malavuwe scheme are reported to have reasonable levels of production. High pumping costs were also constraints.

The Mangondi project is a new project which is not yet fully operational. Paswane was originally developed as a coffee scheme. It has now been changed to a sub-tropical fruit project. At this stage only bananas have been established.

The majority of the 24 participants in the Maizvule project have been successful in producing vegetables. This has come about through good extension advice, as well as an

active savings club which has resulted in participants operating on a cash basis. Productivity on the Mhingu Xikundu project is well below optimum and suffers from a lack of funding.

The Coetzeesdraai flood irrigation scheme was established in the early 1950's with little consultation with beneficiaries. All cultural practices were carrried out by the management agents in collaboration with extension officers. The majority of participants (85%) were females. Major crops grown were maize and wheat, using commercial technology. Yields were reasonable (Bembridge and Sebotja, 1992)

In contrast to the Coetzeesdraai scheme, participants in the Dingleydale project eventually took over management of the scheme from government ; almost half the participants (48%) were males. This scheme is a large producer of vegetables, with tomatoes for canning, cabbages and onions as the main crops. Each individual makes his own management decisions. Although some farmers showed reasonably high levels of farm income, because of the low levels of inputs and technology used, productivity was considerably below optimum on most holdings (Bembridge and Sebotja, 1992).

The Grootfontein scheme started off as a "top down" project, and later developed into a non-participatory co-operative central farm run by a government official. Ploughing services were provided and the cropping programme was decided by the management. In addition, participants were each allocated a food plot for vegetable growing. Shareholders assisted under supervision with cultural practices. Irrigation was through a centre pivot system. Maize for food consumption occupied about one-third of the area with the remainder devoted to cotton, dry beans and wheat in winter, using commercial technology. Eighty per cent of the participants were in employment, with women doing most of the work (Bembridge and Sebotja, 1992)

Because of a series of droughts and consequent water shortages the Mamuhohi, Cordon, Diepkloof, Mphaila, Capes Thorn, Mandiwana and Phadzima schemes have all performed badly with very low levels of productivity. The economy of these schemes, with plot sizes of 1 - 2 ha is based on maize, dry beans, groundnuts, tomatoes and onions. Crop yields on the Garside, Mphephu, Rabali and Beaconsfield schemes achieved slightly better performances, but shortage of water was also a problem.

The Homu, Selwane, Phaswana, Sarangwa, Hozane and Mariveni schemes based on citrus, bananas, and other sub-tropical fruit are reported to be producing at a reasonable level. The same applies to the Olifants River maize and wheat schemes.

Production levels on the Dumfries, Mwanedzi, Tswelopele and Middle Letaba schemes can only be described as fair, while production levels on the Tshiombo, New Forest, Mabanda and Sekovoro schemes are reported as being very poor.

An evaluation of individual farm performance on the Hindostan, Veeplats, Haakdoringdraai, Wonderboom, Nooitgesien, Krokodil, Vlakspruit, Brakfontein,

Vlakplaas, Volstruiskoppies, Gataan, De Paarl, Platklip and Montevideo schemes based mainly on a maize/wheat economy revealed that 55% of participants had very low levels of production, while the remainder (45%) could at best be classed as "fair". The reason for low levels of production was due to poor maintenance of pumps and equipment, low levels of farming skills, age of farmers, lack of ploughing services and credit facilities, as well as water shortage due to drought.

The Dewerani and Nesongani schemes based on pumping from the Levubu river have all experienced water shortages during drought years, as well as breakdowns and poor maintenance of pumping equipment. Production standards are reported to be very variable, with one-third having poor levels of production. A similar situation applies to the Khumbe scheme.

Production levels of participants on the Tshombo Block scheme are in most cases (87%) reported to be extremely low. This is due to water shortages, lack of draught power and poor management.

Of the 595 participants in the Government managed Sanan, Dzinde, Palmaryville, Dopeni, Murare, Folovhodwe, Klein Tshipise, Mutele and Rambuda schemes, less than one in five (17%) were reported as having acceptable levels of production, while two in five (43%) had very poor levels of production. As with other schemes reported on above, the main problems were with breakages and poor maintenance of irrigation infrastructure and equipment, shortage of water during droughts, and poor cultural practices.

The 11 schemes surveyed by Stewart Scott Inc. (1998) revealed the same common problems as discussed above, including small and non-viable plots, lack of security of land tenure, low levels of production, lack of easily available credit and markets, inadequate extension services and training, lack of participation, poor water supply management and deteriorating infrastructure, as well as weak leadership and local organisations.

It was not within the terms of reference of this study to investigate irrigation schemes which had not been settled by small-scale farmers. According to statistics supplied by the Northern Province Department of Agriculture (Northern Province Department of Agriculture, 1998), as well as statistics obtained by the writer, there were at least 61 commercially run schemes in the Province, comprising approximately 36 000ha. While all such schemes have created considerable employment opportunities, previous evaluations have shown that some of these schemes are uneconomic and a great financial burden to government (DBSA, 1995 - Sauerman- personal communication).

3.4.3 Crop production and yields

As in the other provinces, a wide range of food and crops were produced on irrigation schemes in the Northern Province, with maize being the most important food crop (Table 3.9).

During the past few years drought conditions have prevailed in the Province resulting in a general shortage of water which limits all year round crop production. This is particularly apparent in community development schemes where additional constraints include inadequate pumping and water storage works.

Crop yields, both individually and between schemes, varied significantly. The level of management on schemes was also extremely variable. Inadequate cultural practices, such as poor weed control, low plant populations and inadequate pest control contributed to low yields. There was a strong correlation between production standards and the level of training provided.

3.4.4 Future development

It is important for future development that the Northern Province Department of Agriculture complete a full inventory of small-scale farmer irrigation schemes in the Province. This will greatly facilitate future planning and rehabilitation of irrigation schemes, as well as ensure optimum use of scarce water resources to the benefit of disadvantaged communities. A start has already been made in this direction.

3.5 CONCLUSIONS

The following are some general conclusions based on the data in this chapter, as well as the writer's observations, discussions and contacts with small-scale farmer irrigation schemes in South Africa over some 20 years.

A major problem which has emerged over the past five years is that provincial governments no longer have the resources to continue funding management of small-scale farmer irrigation schemes. Because of the previous "top down" approaches to management in most cases, participants do not have the resources, nor the skills to operate schemes themselves. This has resulted in partial or complete collapse of some schemes. Many schemes are in a state of impasse because of failure to transfer responsibility to participants, who in turn do not have the resources or ability to break the cycle and take over responsibility for managing schemes themselves.

The limited data on individual projects only allows for generalisations to be made, which may not necessarily apply in all instances. Data from this survey, as well as international experience, lead to the conclusion that successful small-scale farmer irrigation schemes depend on integration between technology, management, participants and the socio-economic situation. Many important lessons can be learned from past mistakes in Africa and in South Africa, which need not be repeated. Except for some of the sugar cane projects in KwaZulu-Natal, in almost every case small-scale farmer irrigation schemes are linked to the government for technical and financial assistance, as well as for advice and training.

Despite huge investments, the performance of most of the small-scale farmer irrigation schemes has been poor. Exceptions are the sugar cane schemes in Kwa Zulu-Natal.

There have been technical, engineering and organisational failures. The engineering failures led farmers to distrust the reliability of water on offer. However, the major cause of that was due to poor management. Others were operating unsatisfactorily for a combination of social and technical factors; they were subject to poor maintenance or there was conflict between communities or with project management. There was also a large element of non-accountability; and availability of generous farmer support packages ensured the continuation of many projects, even though it led to farmers accumulating large debt loads. On many projects a big gap lies between the level of technology and the level of performance.

Of some concern are the 22 irrigation schemes (4257 ha) in the Northern Province managed by government or development corporations, which have not been settled, and are operating at a substantial loss to government

The history of irrigation schemes in South Africa has not been one of participation by, or consultation with, the supposed beneficiaries. Except for the sugar cane schemes in KwaZulu-Natal, there were no formally constituted Water Users' Associations or similar local organisations; although farmer liaison committees do exist on many of the larger schemes, they lack strong leadership and managerial competence. Feedback from various schemes showed that participants' level of satisfaction was generally low, due mainly to lack of security in terms of credit, inputs, market access and extension services.

Large scale irrigation projects have been imposed and conceived essentially on the basis of civil engineering and crop technology criteria, and without adequate knowledge of all other production and socio-economic parameters.

The present irrigation land allocation and tenure system undoubtedly has an inhibiting effect on irrigation development, particularly on commercially oriented schemes. Farmers on the larger "commercial" irrigation units invariably perceive the need for individual land ownership, which will provide security and incentives, and where market forces can operate and land change hands. This will allow the more efficient farmers to consolidate land units into a viable farming proposition, as well as provide collateral for inputs and credit.

The government Green Paper on land reform suggests that local communities should decide on the best form of tenure to meet their needs. It should be recognised that any land reform programme has to take into consideration the views of households without irrigation rights, as well as non agricultural issues, such as urban security of tenure, and old age security. These issues may well cause local conflicts of interest.

Besides the problem of security of tenure, the large Makhatini, Ncora, Qamata, Tyefu and Thukela Estates projects have not been effective mainly because of inadequate decentralisation of power and responsibilities, and non-accountability of the decision makers. The project participants have, over the last two decades, developed a sense of inferiority complex to manage their own holdings. This has resulted in farmers looking to

government or government appointed management agencies for the operation and maintenance of the project with consequent inefficiency and cost ineffectiveness. The top-down bureaucratic approach tends to kill grass-root initiative and endeavour.

This type of development was based on the mistaken assumption that technological innovations *per se* would be sufficiently attractive to automatically stimulate farmer participation. Farmers were simply left out of the planning, design and implementation phases. They were not sufficiently informed as to what their future role was expected to be in the operation and maintenance of the project. Farmers tended to perceive agricultural inputs and services as more important to them than the irrigation system's effectiveness. Farmers' perceptions have been affected by the 'benevolent autocratic" style of management applied on most irrigation systems. This resulted in over-dependence of farmers on government and other management agents for their farming operations.

Many scheme managers are well versed in the technical aspects of irrigation, but often lack the social skills that are necessary to effect integration of participants into the operation and maintenance of the scheme. There has generally been an over-dependence of farmers on government agencies for their farming operations. In all, the involvement of farmers in managing irrigation schemes has been very informal and often non-existent. On most schemes the relationship between farmers and project management, is that of a customer and supplier, and farmers perceive management as an external organisation.

On the majority of schemes no charges are levied on water supplies. On small-scale farmer schemes it is not practicable to meaasure water on each plot. This can only be done at source and charged pro-rata.

Economic analysis was beyond the scope of the current provincial surveys. In any event, the existence of secondary social and other benefits, make a realistic analysis of individual projects very difficult, but it is unlikely that on present performance most schemes can be justified purely on economic grounds. Where data of farming units existed, the total gross margins of farming units on most schemes were poor. As might be expected on the smaller farming units farm surplus was low. Irrigation development based on high return cash crops can yield returns close to those of non-agricultural investments.

Lack of properly qualified scheme management, water bailiffs, extension staff and farmers is a major drawback to the effectiveness of many schemes. Training programmes at all levels are a high priority. Assessment of training needs should be the basis of any well planned institutional upgrading.

Extension services have been traditionally weak in the small-scale farming sector and not well oriented to irrigated agriculture. If irrigated agriculture is to substantially increase productivity, there is a dire need first to train extension staff, and secondly, to transfer knowledge and technology to farmers. The use of demonstration trials has a great potential.

Small pump schemes from dams and boreholes play a very important role in augmenting food production through small foodplot irrigation schemes. A problem has been lack of maintenance of pumping equipment. In many instances participants perceive this as the responsibility of "government".

On many projects the use of centre pivots and sprinklers has not only proved costly, especially for the cultivation of low value crops, but also unsuitable for small-scale farmers due to poor maintenance, theft and damage. Research has shown that well-planned gravity irrigation in-field systems have proved just as efficient, and certainly more economic, than centre pivot, sprinkler or drip systems (Stimie, 1996).

CHAPTER 4

TYEFU IRRIGATION SCHEME

4.1 GENERAL DESCRIPTION AND HISTORICAL BACKGROUND

The development of an irrigation scheme at Tyefu near Peddie was first considered in the 1930s. At that time the high salinity of water from the Fish River was considered a major constraint (van Averbeke, M'Marete, Igodan and Belete, 1998).

The Tyefu irrigation scheme is designed to provide bulk water to irrigate some 5400ha on the east and west banks of the Great Fish River, in the Committees Drift Tyefu area some 35 kms east of Grahamstown. Approximately 2930ha of this land is located on the east bank (former Ciskei). After further investigations a pilot project was developed on the East Bank (former Ciskei) in 1976. The scheme is situated in one of the most eroded, impoverished and drought stricken areas of the Eastern Cape (Bembridge, 1986b).

Initially 230ha was developed at Ndlambe and Pikoli in 1977 and 1978 respectively, followed by a further 106ha at Kalikeni in 1981. A further 137 ha was developed in 1984 and 171 ha in 1986, making a total of 644 ha, of which 228 ha comprises an estate and service unit previously controlled by management (Figure 1). Part of this area has been allocated to 0,2ha food plots. Approximately 1000 ha of irrigable land remains undeveloped. Current allocation of land is shown in Table 4.1.

Table 4.1 Plot size distribution at Tyefu irrigation scheme, 1998

Type of unit	Number	Average ha.	Total ha
Commercial farms[1]	32	4,00	128,0
Food plots	223	0,25	56,0
Food plots	547	0,20	109,0
Food plots	717	0,16	115,0
Central unit	1	228,00	228,0
Total	1520	-	636,0

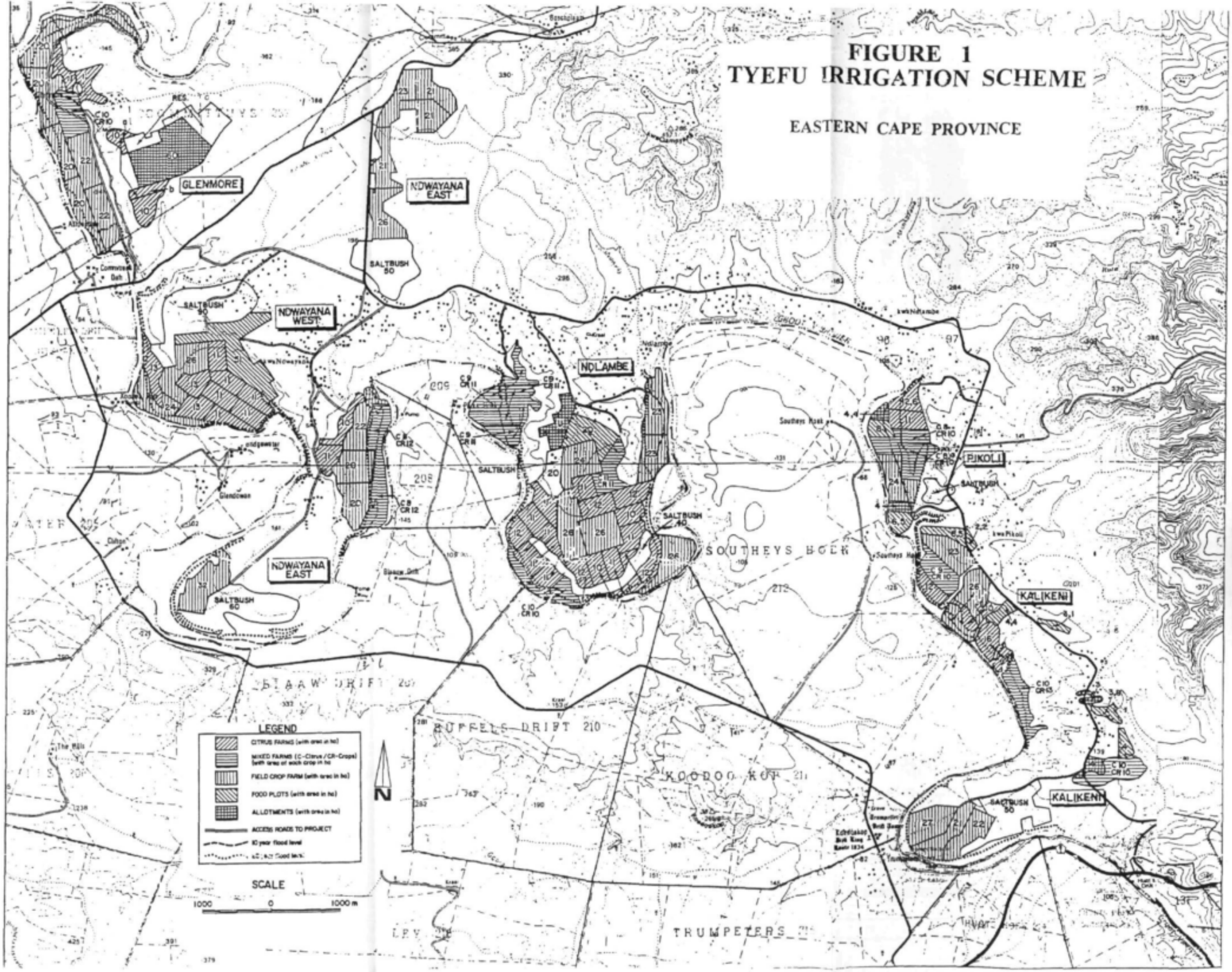
[1] 32 plots allocated

4.2 PROBLEM DEFINITION

From the outset it was realised that the scheme was not economically viable. However, because of considerations of poverty alleviation and the fact that in due course the present pumping scheme would be superseded by a gravity canal scheme, the Ciskei Government of

FIGURE 1
TYEFU IRRIGATION SCHEME

EASTERN CAPE PROVINCE



the day decided to proceed with the scheme (Inter-Science, Ciskei, 1984). The major problems facing the scheme after the withdrawal of management by ULIMOCOR in 1995 resulting in partial closure in terms of cutting off water supplies and withdrawing service of the scheme, include:

- The project was running at a large operational loss (circa R1million) prior to management withdrawal in 1995.
- High electricity pumping costs at Ndlambe, Pikoli and Kalikeni make irrigation under present systems completely uneconomic.
- Water quality from the Great Fish River is a major problem which has affected yields on Ndlambe, Pikoli and Kalikeni sections (Figure1).
- Withdrawal of management has resulted in unemployment on the central unit, as well as lack of self-employment opportunities on the scheme itself.
- The community was divided between two rival Farmers Associations, Eastern Province Agricultural Union (EPAU) and Eastern Cape Disadvantaged African Farmers Union (EDAFU). Most commercial farmers belong to the former. During 1999, there was some success in getting the two associations to work together.
- Farmer participation in the scheme has been restricted to representation on the Irrigation Action Committee.
- Only commercial farmers were able to easily obtain credit for inputs because they had a greater chance of repaying loans.
- Marketing of crops, including transport, has always been a problem on the scheme.
- Although commercial farmers have acquired a reasonable level of knowledge and skills in irrigation schemes, the majority of foodplot holders still need to acquire adequate skills through training.
- Local extension staff are ill equipped to provide sound training and advice on irrigation farming and farm management.
- Due to the "top down" nature of the project, there has been inadequate training and development of local institutions.
- Much of the above ground irrigation equipment is 15 years old and needs replacing.

4.3 PHYSICAL FACTORS

4.3.1 Climate

4.3.1.1 Rainfall

Table 4.2 depicts the approximate monthly distribution of rainfall in the Tyefu irrigation scheme area.

Table 4.2 Mean monthly rainfall, Tyefu irrigation scheme in mm.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Total
Rain	58	58	40	51	58	63	44	31	15	12	15	30	475
No of days	5	5	4	4	5	5	4	3	2	2	2	4	45

Mist in late summer and late autumn is a distinct feature of the local climate.

4.3.1.2 Temperature

A feature of temperatures from the point of view of crop production is the marked daily range in temperatures. Mean daily temperatures are given in table 4.3.

Table 4.3 Mean daily temperatures, Tyefu irrigation scheme °C

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
22,8	23,1	22,1	19,1	16,1	13,8	13,4	14,6	16,3	18,1	19,6	21,3	18,4

4.3.1.3 Surface winds

Wind direction and velocity can have variable effects on sprinkler irrigation uniformity of distribution. Available data show winds blow most frequently from the south-west, west and north-west with an average velocity of 22 km/h (Loxton, Hunting and Associates, 1976a).

4.3.2 Soils

The soils of the area have been mapped by the then Department of Agricultural Technical Services. The soils are of two main types:-

(a) Medium textured, red, structureless soils of Hutton Form on pediments and higher lying terrace remnants. These are mostly reasonably deep soils.

(b) Light to medium textured, deep brown soils on younger alluvial terraces bordering the river in places.

The average total available moisture capacity of the soils is estimated at 19%, which is very satisfactory (Loxton, Hunting and Associates, 1976 b). The irrigation potential of the soils is indicated in Table 4.4.

Table 4.4 Irrigation potential of soils, Tyefu irrigation scheme.

Potential	Extent ha
Moderately high to high	1893
Moderately to moderately high	572
Moderate (marginal)	379
Low to moderately low	290
Total	**3134**

There is evidence of salt accumulation in some areas due to the salinity of the Great Fish River water.

4.3.3 Topography

The scheme is 60 - 125m above sea level- 33°09,5' south and 26°50' east. The entire area is drained by the Great Fish River which forms the western and southern boundary of the irrigation scheme. Slope gradients range from flat to 4% on lower alluvial terraces and from 4% to 10% on upper terraces and lower pediments. The upper limit of suitable soils is generally the 120m contour line, above which gradients change to 20% - 40% above this contour.

4.3.4 Water Resources

The water supply system is depicted in Figure 2. The water resources have been thoroughly studied. Records show that there is a 50-65% probablilty that the required maximum monthly flow from the Great Fish River for the irrigation scheme will not be available for the months of May to October. Data on deficit flows for various recurrence intervals have been calculated. In essence the quality of water during periods of low flow is such that it presents a salinity hazard (Loxton, Hunting and Associates, 1976b). A general conclusion is that a successful and sustained irrigation scheme can only be developed if water is made available from the Orange River scheme.

At present water for irrigation is pumped from the Great Fish River into storage dams constructed on local tributaries or pumped to the irrigated lands. Water supplies are derived from 6 independent schemes (Figure 2):-

a) Glenmore - Committees Drift (117ha) direct pumping from the Great Fish River.

b) Remainder of Glenmore (55ha) pumped to a dam and purification plant. Water is pumped to a million litre reservoir and gravitated to communal standpipes in the villages.

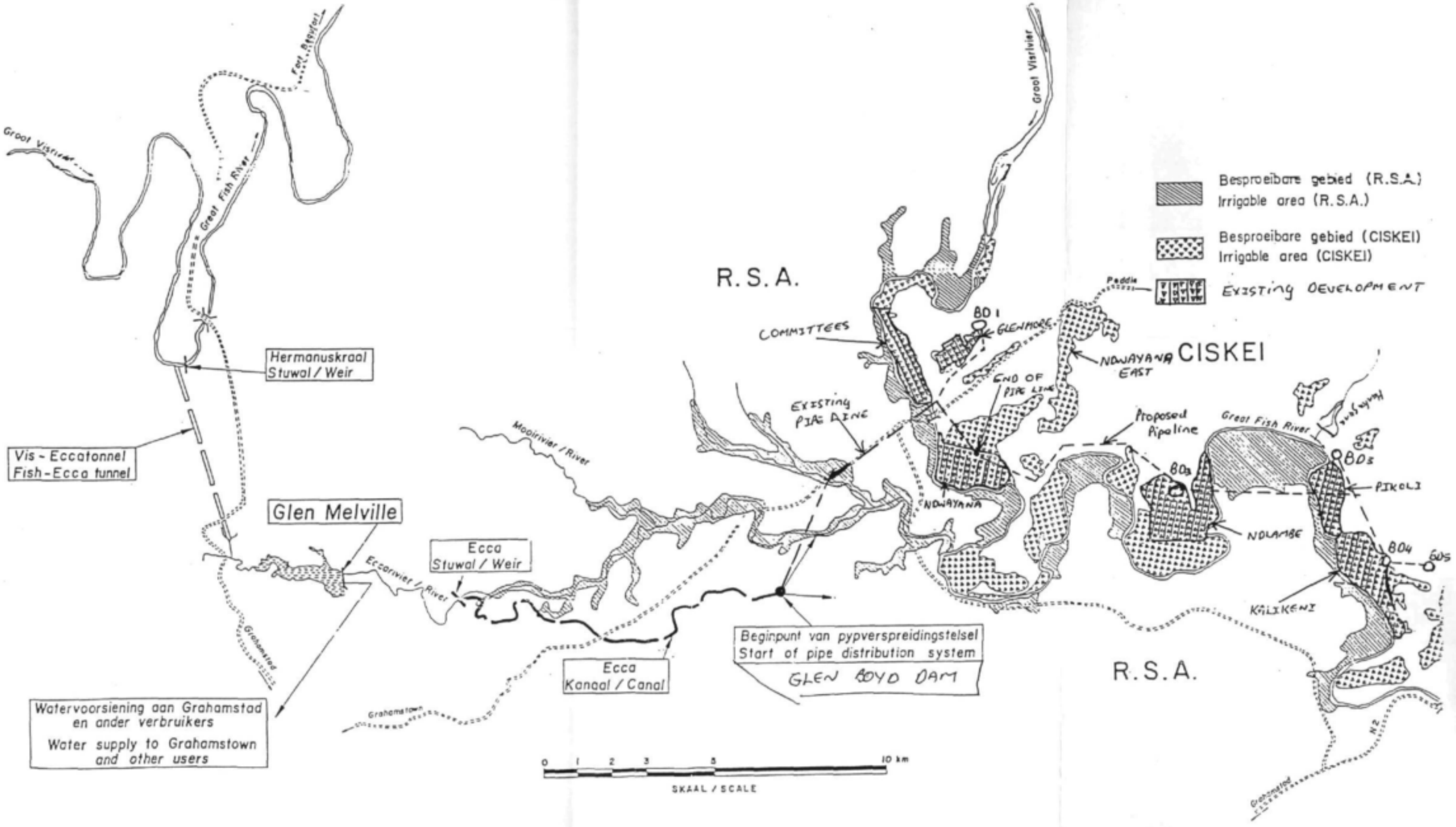


FIGURE 2 LAYOUT OF PROPOSED LOWER FISH RIVER IRRIGATION SCHEME, INCLUDING TYEFU

c) Ndlambe section (151ha) water is stored in two earth dams on the Nqwelo River, a tributary of the Great Fish River. Water is pumped from the Great Fish River to augment the lower dam. Domestic water is treated and supplied from the latter supply to the village.

d) The Pikoli section (113ha) is supplied with water from dams on the Mankazana and Riva tributaries of the Great Fish River. The Mankazana dam water supply is augmented by pumping from the Great Fish River.

e) The Kalekeni section (105ha) water supply is derived from the Singumani Dam as well as pumping from the Great Fish River.

f) The Ndwayana food plot scheme (55ha) is supplied with water pumped from the Great Fish River to a reservoir from where it is gravitated to the irrigation plots.

From the above it is clear that the yield of the dams and the Great Fish River falls short of the peak demand period. In addition the quality of water from this source is also a constraint. Furthermore, pumping costs to supply irrigation water to Ndlambe, Pikoli and Kaliteni sections are completely uneconomic. Solar energy as an alternative energy source is also not viable (Strategic Consultants, 1998).

The only feasible solution is to extend the main supply line from the Glen Boyd Dam to supply Orange River water to Ndlambe, Pikoli and Kalikeni sections (Joubert, 1998 - personal communication).

4.3.5 Domestic Water Supplies

All villages have communal stand pipes for domestic water. Livestock obtain water from the Great Fish River and its tributaries.

4.4 INFRASTRUCTURE AND SERVICES

4.4.1 General Infrastructure

The development of the irrigation scheme has resulted in infrastructural development which otherwise might not have reached this remote area.

4.4.2 Power supply

The scheme is supplied with electricity for pumping by ESKOM. Due to failure of Government to subsidise power costs, the supply for pumping has been discontinued.

4.4.3 Education facilities

The project is served by seven schools situated in Enxuba, Ndwayana, Qamanya, Pikoli (2), and Ndlambe (2).

4.4.4 Health services

There are clinics at Enxuba and Ndlambo. The nearest hospital is at Peddie and a mobile clinic also operates in the area.

4.4.5 Retail outlets

There are several small local retail outlets on the scheme. However, these small businesses do not carry farming inputs which have to be obtained from nearby towns. Previously farming inputs were supplied by the scheme management.

4.4.6 Inputs and markets

Up to 1996 commercial farmers and some food plot holders were able to obtain loans for inputs from the Ciskei Agricultural Bank. The repayment record was generally poor, especially among the food plot holders. Previously draught power was provided by the scheme management. This has been discontinued and farmers have to rely on local contractors and animal draught power.

The scheme is situated aproximately 150kms from the main market centre of East London. High transport costs aggravate the difficulties of marketing produce.

4.4.7 Recreational facilities

There is a general lack of recreational facilities and amenities on the scheme which has resulted in migration of many youths to larger centres.

4.4.8 Irrigation infrastructure

It is some 15 years since the scheme was developed. In the past, scheme participants have relied almost entirely on scheme management for the maintenance of the main water supply systems, draglines and sprinklers. Much of the above ground piping and equipment is in bad shape and needs to be upgraded. Sprinklers need to be replaced, preferably with drag lines.

4.5 LOCAL ORGANISATIONS

Farmer leadership on the scheme is generally weak. This is compounded by the political rivalry of the two farmers unions, EPAU and EDAFU. However, more recently agreement was reached on forming a central committee comprising five members from each union charged with negotiating the future of the scheme.

4.6 CROPS AND LAND-USE

A fairly comprehensive study of crop production options was carried out by Loxton, Venn and Associates (1987). Over the years a number of crops have been tested on the scheme and a

narrow range of options arrived at. In order of gross margin per hectare the following are the most important crops: Soft citrus and navel oranges (not currently produced); baby carrots (for freezing); cabbage, potatoes, cauliflower, brussel sprouts, dry beans, durum wheat, cotton and maize. Other crops considered suitable, but not very profitable include soyabeans, sweetcorn, dry peas and groundnuts (Loxton Venn and Associates, 1989).

There is no doubt that at present export citrus offers the best long term prospect of a sustained economic return. A 100ha project has been planned for the Glenmore/Ndwayana area with ten farmers, each with a 10ha unit (Loxton Venn and Associates, 1989). A stumbling block has been differences of opinion among the communities on land tenure issues. Long term finance cannot be secured without security of tenure.

More recently, sugar beet has been suggested as a suitable crop which apparently has been tested in the Fish River valley. However, the proposed siting of the mill at Cookhouse some 140kms distant may make marketing costs a problem in the long term.

4.7 PARTICIPANTS' PERCEPTIONS

Nine groups representing the two farmers associations, EDAFU and EPAU, comprising 10-12 representatives each were interviewed. A summary of the results of the discussions is given below.

4.7.1. The Scheme

Respondents perceived the original objectives and expected benefits of the project as food security, income, employment, overcoming poverty, farming skills and general development of the area. About half the respondents perceived that they had not benefited from the scheme. Commercial farmers had benefited in terms of both food and income, while food plot holders benefited from food security. Other perceived benefits were employment and skills.

About one-third of respondents perceived the project as being of a "top down" nature, while others mentioned former Ciskei leader, LL Sebe as being instrumental in launching the scheme. Respondents were divided in their perceptions on the degree of consultation, some perceiving that only the Tribal Authority had been consulted.

4.7.2. Farmer selection

About half the respondents were dissatisfied with the method of farmer selection, expressing the view that the selection was undemocratic. Some respondents perceived that selection of commercial farmers was done by the Tribal authority, with foodplots being allocated to others. Others felt selection was based on compensation for land taken over by the scheme.

Those dissatisfied with farmer selection felt selection should have been more democratic and plot sizes should have been equal. Others felt farmers should have been trained before they were allocated plots.

4.7.3 Scheme services

Because of the breakdown of the scheme farmers were naturally dissatisfied with the present lack of services provided to farmers and expressed dissatisfaction with ULIMOCOR terminating their management services.

4.7.4. Credit, inputs and markets

Only commercial farmers were able to obtain credit from the Ciskei Agricultural Bank and some were in default on payments. Many food plot holders had up to now been unable to obtain credit.

Groups were unanimous that marketing of crops was a major problem on the scheme. Roads were poor, there was no local storage and transport of produce was often a problem. Apparently a fresh produce market is to be built at Peddie.

4.7.5. Irrigation technology

The majority of groups expressed dissatisfaction with present irrigation technology. Some of the food plot holders did not have access to taps and others felt sprinkler systems needed to be modified and improved. There was a need to obtain Orange River water for the entire scheme because of problems of salinity with Great Fish River water. There was also concern with high pumping costs and it was suggested that solar power be considered.

4.7.6. Water charges and allocations

Farmers expressed a willingness to pay for water provided it was affordable. At present only commercial farmers pay a nominal amount of R100 per season. Respondents were generally satisfied with the timing of water allocations, but felt distribution could be improved and in some cases underground layouts changed. Water shortages had been experienced in the past due to pump breakdowns.

4.7.7 Financial results of farming units

There was no reliable data on financial results. While management was in place, a proportion of commercial farmers were perceived as making a reasonable income, while foodplot holders had benefited in terms of food security (Refer para. 4.9.4.1)

4.7.8. Livestock on the scheme

As with most small-scale farmer irrigation schemes, livestock are allowed to graze on the lands often causing damage to crops. Respondents suggested improved fencing as the solution.

4.7.9. Farmer participation

Respondents were unanimous that there should be greater farmer participation in running the scheme, especially in decision making and administration. Farmers appear to be divided as to whether they should be personally active in running the scheme.

The majority of respondents were in favour of restructuring management and forming a company or co-operative to run the scheme. There was general agreement that farmers would need further training in order to participate more fully in management.

It was generally felt that over time management, input supplies and marketing should be transferred to farmers. However, it was felt that external assistance would still be required for some time to come.

4.7.10. Scheme maintenance

At present the ULIMOCOR liquidators are responsible for maintenance. Recently a committee comprising 5 members from each Farmers Association was formed to oversee maintenance of the scheme, including employment of security guards. Respondents were unanimous that farmers should be more involved in scheme management through a trust company or co-operative. Farmer training should be an integral part of taking over scheme maintenance.

4.7.11. Role of farmers' committee

Respondents were divided as to whether the present scheme committee was doing a good job. Those who were dissatisfied felt there should be greater transparency and consultation, and a new committee should be elected. In fact this has happened since this investigation was started (Refer 4.7.10 above). It was unanimously felt that the Committee would need to be trained in a wide range of skills, including management, administration, financial management, communication, technology and marketing.

4.7.12. Scheme conflicts

When this investigation was first launched there was a conflict between the two Farmers Associations, EDAFU and EPAU. Since then the Restructuring Committee has succeeded in getting the two associations to work together.

4.7.13. Gender issues

Respondents were in unanimous agreement that women played an important role on the scheme, especially in weeding and harvesting. It was felt that women could participate more fully by serving on the committee and having their own food plots. In general, gender issues were not considered a problem on the scheme.

4.7.14. Land tenure

Two-thirds of the groups interviewed were dissatisfied with the land tenure system and felt farmers should be given title to the land. The remainder felt the *status quo* should remain because the land belonged to the Tribal Authority. All groups expressed dissatisfaction on the size of plots allocated. Commercial farmers felt a reasonable unit was 10ha, while foodplot holders' suggestions on plot size varied from one to six hectares.

4.7.15. Farmer training needs

All respondents were unanimous on the need for further farmer training. The most important needs expressed were for training in irrigated crops, interpretation of financial statements, management, tractor driving, farm mechanics, plumbing and marketing.

4.7.16. Extension services

Two-thirds of the groups interviewed were dissatisfied with extension services. There was only one extension officer resident on the scheme. Besides the need for additional staff, it was felt that extension officers should be more specialised in irrigated crops and irrigation techniques and fall under the control of the scheme management.

4.7.17. Cropping systems

Previously foodplot holders were cultivating maize, cabbage, potatoes, spinach and beetroot, while commercial farmers were growing maize, baby carrots for canning, and cabbage. Maize was sold for "green mealies" as well as for grain. The objectives of both categories of farmers were to produce both for food and for sale.

Food plot holders were interested in growing tomatoes, potatoes and other cash crops, while commercial farmers expressed an interest in producing sugar beet and paprika; crops being advocated by the Provincial Department of Agriculture, but still untried in the area. Commercial farmers and some plot holders were also interested in growing wheat and barley, sunflowers and lucerne, as well as citrus.

4.7.18 Scheme impact

Eight out of the nine groups interviewed felt that living standards had improved since the scheme started. It was perceived that there was more food, improved domestic water supplies, more jobs, improved infrastructure such as schools, farmer training and less crime.

4.7.19. Political support

Groups were divided on whether there was good political support for the scheme. It was felt that the Transitional Rural Council should be represented on the scheme committee.

4.7.20 Scheme rehabilitation

Respondents were unanimous that the scheme should be rehabilitated. The perceived needs for rehabilitation included greater farmer participation, modernising irrigation technology, fencing off arable land, farmer training and access to Orange River water, which was currently only available on the Ndwande Section.

4.8 EXTENSION OFFICERS' KNOWLEDGE OF IRRIGATION

Extension officers from the Eastern Cape (Tyefu) and KwaZulu/Natal (Bululwane) working on irrigation schemes were asked to rate their own knowledge of common irrigated crops and related knowledge of irrigation, farm economics and extension (Table 4.5).

Table 4.5 Extension officers' perceived knowledge ratings, 1998 (N=10)

	Knowledge rating				
Subject	**Very good %**	**Good %**	**Fair %**	**Poor %**	**Very poor %**
Maize under irrigation	10,0	60,0	20,0	10,0	-
Cabbage production	30,0	40,0	20,0	10,0	-
Carrot production	30,0	40,0	30,0	-	-
Potatoes	-	60,0	40,0	-	-
Onions	10,0	50,0	40,0	-	-
Beans	-	40,0	50,0	10,0	-
Irrigation scheduling	-	30,0	60,0	10,0	-
App. of irrigation water	-	50,0	50,0	-	-
Farm economics	-	50,0	10,0	40,0	-
Communication skills	20,0	70,0	-	-	10,0
Extension programming	10,0	40,0	50,0	-	-

On the assumption that a Fair rating implies a need for further in-service training, 30-40% of extension workers perceived the need for further training in irrigated crop production. A higher proportion (>50%) perceived a need for further training in irrigation scheduling, water application and farm economics. While the majority of extension workers perceived they had knowledge of communication skills, one or two felt a need for further training in extension programming. The writer's impression was that there was very much an *ad hoc* approach to extension on all the case study schemes.

Extension officers were also asked to assess their own competency to provide advice to farmers on important irrigation practices (Table 4.6).

Table 4.6 Extension officers' perceptions of their competence to provide advice to farmers on irrigation practices, 1998 (N=10)

Competence rating					
Topic	**Very good %**	**Good %**	**Fair %**	**Poor %**	**Very poor %**
Soil profile interpretation	10,0	30,0	50,0	10,0	-
Land preparation	10,0	60,0	20,0	10,0	-
Fertilizer applications	10,0	60,0	40,0	-	-
Irrigation scheduling	-	40,0	40,0	20,0	-
Application of water	10,0	70,0	20,0	-	-
Measuring infiltration	-	60,0	-	20,0	20,0
Calculated evapo-transpiration (pan method)	-	30,0	20,0	50,0	-

Except for land preparation and water application, at least half the extension officers perceived the need for further training in irrigation techniques aimed at improving their competence.

Extension officers were given five multiple choice questions concerning critical plant growth stages for water application, irrigation scheduling, water logging and early plant growth irrigation. Results showed that they had an over optimistic perception on giving advice on irrigation scheduling and water applications. On average, not more that 30% gave the correct answer to each question.

4.9 SCHEME PARTICIPANTS

4.9.1 Introduction

The following are the results of a household survey of all available (83%) commercial farmers and a 5% stratified random sample of food plot holders. The plots were allocated between 1977 and 1986. Management of the scheme was discontinued in 1995. Shortly after this irrigation pumping ceased due to the Government's decision not to continue subsidising ESKOM power.

4.9.2 Personal characteristics

Seventy five per cent of commercial plots were allocated to males, while this was the case in 70% of foodplots. There was a greater proportion of female headed households among foodplot holders, who were particularly disadvantaged (Table 4.7).

Table 4.7 Personal characteristics of commercial (CF) and foodplot holders (FPH) heads of households, Tyefu irrigation scheme, 1998. (N=92)

Characteristic	Commercial farmers (N=24)		Food plot holders (N=70)	
	No.	%	No.	%
Marital status				
Male headed	19	79,2	47	67,1
Female headed	5	20,8	23	32,9
Age Group				
< 40 years	2	8,2	16	22,8
41 - 50 years	1	4,2	15	21,4
51 - 60 years	5	20,8	11	15,7
61 - 70 years	4	16,7	10	14,3
> 70 years	12	50,0	18	25,7
Education level yrs				
No education	10	41,6	36	51,4
0 - 4 years	7	29,2	9	12,9
5 - 6 years	3	12,4	9	12,9
7 - 8 years	2	8,4	10	14,2
> 8 years	2	8,4	6	8,6

It is assumed that increased age does not seriously impair the ability to manage the small-scale agricultural holding at least up to 60-65 years of age. Of particular concern in this study is the high percentage of commercial farmers over 70 years of age. Besides lacking physical strength, this age group do not have the same incentive and motivation to increase income and living standards, and are largely dependent on income from pensions. The role of other family members in farm management was not investigated.

The average family size of members living at home was 5,83 and 4,74 among commercial farmers and foodplot holders (FPH) respectively. Average total family size was 8,0 (CF) and 6,48 (FPH).

According to educationalists, people with less than 4 years education are unlikely to have attained any degree of functional literacy (Koshy, 1977), which according to Table 4.7 includes 71 per cent of commercial farmers and 64 per cent of food plot holders household heads. Female heads of households were less well educated than their male counterparts. However, the literacy rate among children has increased dramatically in recent years.

4.9.3 Socio-economic characteristics

Household income and expenditure is a most crucial variable in two respects. Firstly, income and expenditure is a measure of relative well being, and secondly it illustrates the degree of dependence on local farm and non-farm resources.

Table 4.8 Mean monthly household expenditure, expenditure on food and pension income, Tyefu irrigation scheme, 1998 (N=94)

Category	C.Fs (N = 24)	FPHs (N = 70)
Monthly expenditure (R)	1052,00 (575)S^2	672,00 (436)S^2
Expenditure on food (R)	502,00 (200)S^2	437,00 (236)S^2
Average pension income(R)	528,75 -	342,42 -

Because of lack of records and the general sensitivity and difficulties in obtaining data on household income, it was only possible to obtain approximations of total monthly expenditure and expenditure on food. Only 4.2% of CFs and 1.4% of FPHs maintained they were able to save any money. In the majority of households, household expenditure approximates to total income. In both categories approximately 50 per cent of monthly expenditure was derived from pensions (Table 4.8).

According to Whiteford, Posel and Ketlatwang (1995) the minimum subsistence level adjusted for inflation of a rural family of 6 persons is approximately R1110 per month. On the assumption that most lower income households would have minimal savings, it can be concluded from the data that 61% and 86% of commercial farmers and foodplot holders respectively are living in varying degrees of poverty.

To illustrate the effects of closing the scheme and consequent increased poverty on expected reduced household income, farmers average total value of crops before closure was R9290 (S^2 7000) and R746 (S^2 587) for CFs and FPHs respectively.

Before the scheme closed commercial farmers were practically self -sufficient in maize, only purchasing 40kgs per annum on average, while foodplot holders on average purchased 320kgs, which is approximately 32% of requirements. This illustrates the importance of the scheme for food security in a very low potential area.

Practically all (96%) of household heads were residing on the scheme. Only 21% of commercial farmer heads of households were in employment, while 38 per cent of foodplot holders were employed. Household income was no doubt augmented to some extent by employment of other family members. Fifty eight per cent of CFs and 36% of FPHs had sons in employment. In the case of daughters, 62% of CFs and 36% of FPHs had daughters in employment. The discrepancy between the two groups may have influenced the higher income of commercial farmers.

4.9.4 Agricultural Production

4.9.4.1 Crops

The previous contribution of irrigated crops to household income was mentioned in 4.9.3 above. To illustrate the current poverty situation respondents were asked to assess the

current quantitative food situation and the situation prior to the scheme closing down (Table 4.9).

Table 4.9 Respondents' perceptions of current food sufficiency and sufficiency prior to closure of the scheme, Tyefu irrigation scheme, 1998 (N=94)

Perception category	C.Fs		FPHs	
	No.	%	No.	%
Current food sufficiency	6	25,0	15	21,5
Previous food sufficiency	20	83,3	61	87,1

It is clear that in the past the scheme has made a major contribution to food security. CFs perceived food security and income of equal importance, while FPHs put more emphasis on food security. The most important crops grown by CFs were maize, cabbage, potatoes and baby carrots, the latter for freezing. FPHs also produced maize, cabbage and potatoes. Other crops grown to a much lesser extent included wheat, cotton, sunflower, soya beans, sweet potatoes, beetroot, cauliflower, spinach and onions. While cabbage yields were apparently reasonable, maize and potatoes were less than half the potential

Probably because of information supplied by the Department of Agriculture, both CFs and FPHs expressed an interest in producing sugar beet and paprika. Other preferred crops for the future included butternuts, potatoes, cabbage, cauliflower, barley, wheat and soyabeans. CFs were satisfied to continue with the same crops as grown previously. They perceived baby carrots to be the most profitable crop followed by cabbage, paprika, potatoes and sugar beet, while FPHs perceived cabbages, potatoes, maize and carrots to be the most profitable crops.

After encouragement by the commercial sector, the majority of irrigators were keen to grow sugar beet for the mill to be erected at Cookhouse by an overseas organisation. They were led to believe that an income of R6000 to R8000 per ha was possible. This still has to be proven on the scheme.

4.9.4.2 Livestock

The Tyefu area is basically suited to semi-extensive livestock production supported by drought resistant dryland crops and irrigation. Most of the grazing areas are in a degraded state due to continuous over-grazing and lack of grazing management. Other than crop residues in winter, there has been little integration of livestock into the farming system.

Cattle

Table 4.10 Cattle owners and herd numbers, Tyefu irrigation scheme, 1998 (N = 94)

Farmer category	Cattle Owners		NO. OF HEAD									
	No.	%	1-2		3-4		5-6		7-8		> 8	
			No.	%	No.	%	No.	%	No.	%	No.	%
Commercial farmers	9	37,5	3	33,3	1	11,1	2	22,2	1	11,1	2	22,2
Food plot holders	19	27,1	4	21,1	7	36,8	3	15,8	4	21,1	1	5,3

From Table 4.10 it is clear that cattle do not play a major role in the average household economy. Only 3 farmers have herd sizes (>8 head) sufficiently large to ensure an annual income from cattle. Most households did not possess sufficient animals for draught power. Overall only 30% of households own any cattle. Only 21% of cattle owners sold any animals over the past year. Respondents complained that cattle and goats often caused damage to irrigated crops due to poor control and maintenance of fencing.

Goats

A larger percentage of CFs (63%) and FPHs (60%) owned goats (Table 4.11).

Table 4.11 Goat owners and herd numbers, Tyefu irrigation scheme, 1998 (N=94)

Farmer category	Goat Owners		NO. OF HEAD									
	No.	%	1-5		6-10		11-15		16-20		>20	
			No.	%	No.	%	No.	%	No.	%	No.	%
Commercial farms	15	62,5	4	26,7	6	40,0	1	6,7	3	20,0	1	6,7
Food plot holders	42	60,0	20	47,6	12	28,6	5	11,9	1	2,4	4	9,5

Goats are kept mainly for home consumption. Only 9% of goat owners sold any goats over a 12 month period.

Sheep

Only two respondents kept sheep, each having five head.

Pigs

About half (53%) of all households in both farmer categories kept pigs. The majority kept four or less pigs, mainly for home consumption. Only 10% of pig keepers were keeping pigs for sale.

Poultry

Forty six per cent of commercial farmers and 21% of food plot holders kept poultry, almost entirely for home consumption.

4.9.4.3 Implements, vehicles and equipment

Four of the commercial farmers owned tractors and were therefore able to hire out draught power to other farmers. Because of the shortage of draught animals, only a small percentage owned ox drawn equipment (Table 4.12)

Table 4.12 Commercial farmers and food plot holders ownership of vehicles and implements, Tyefu irrigation scheme, 1998 (N=94)

Implement/vehicle	Commercial farmers		Food plot holders	
	No.	%	No.	%
Tractor	4	16,7	-	-
Ox plough	4	16,7	8	11,4
Ox cultivator	8	33,3	2	2,9
Ox planter	1	1,4	1	1,4
Trailer	5	20,8	9	12,9
Bicycle	4	16,7	2	2,9
Bakkie	4	16,7	2	2,9
Motor car	4	16,7	3	4,3
Hoes	24	100,0	67	95,7
Spades	17	70,8	50	71,4
Forks	10	41,7	31	44,3

The majority of farmers owned the essential farm tools of spades and hoes.

4.9.4.4 Farm labour

Irrigation farming practices were generally carried out by husband and wife or the wife alone (Table 4.13).

Table 4.13 Household labour inputs of commercial farmers and foodplot holders on various tasks, Tyefu irrigation scheme, 1998 (N=94).

Task	Husband		Husband + wife		Wife		Other	
	CFs %	FPHs%	CFs%	FPHs%	CFs%	FPHs%	CFs%	FPHs%
Planting	12,5	22,9	37,5	44,3	20,8	28,6	29,2	4,3
Irrigation	12,5	27,1	37,5	40,0	25,0	28,6	25,0	4,3
Weed control	12,5	14,5	33,3	52,2	20,8	29,0	33,3	4,3
Harvesting	16,7	14,3	41,7	52,9	16,7	28,6	25,0	4,3
Selling	12,5	15,7	50,0	44,3	29,2	32,9	8,3	7,1

The "other" referred to in the case of commercial farmers is explained by hired labour. The majority of CFs (92%) hired labour against only 6% of FPHs. On average commercial farmers hired 151 labour days per annum compared to only 7 labour days by food plot holders. On a full time equivalent basis (230 labour days), approximately 64 jobs were created on the plots. This is in addition to central unit employees.

The consensus (71%) among most participants was that weed control required the greatest labour input. All commercial farmers hired or used their own tractors for land preparation, while some food plot holders (58%) had to resort to hand labour and animal draught power. There was general dissatisfaction among FPHs concerning land preparation.

4.9.4.5 Irrigation systems

The majority of respondents had more that five years experience of irrigation. One-third of CFs and 19% of FPHs are dissatisfied with present irrigation systems. The former expressed the need to convert from sprinkler to drag line systems. There were considerable differences in irrigation intervals in peak summer months. The modal group was irrigating every third day.

4.9.4.6 Water management, quality and charges

The majority of respondents, especially those with water pumped direct from the Great Fish River, based on personal knowledge and experience, perceived water quality (high salts) to be a problem. At present commercial farmers pay a nominal water charge of R100 per annum, which is completely uneconomic. All commercial farmers and the majority of food plot holders (94%) were willing to pay reasonable water charges. Due to inadequate records no data are available to compare the nominal charge with actual operational and maintenance expenditure.

The majority of both groups (75%) perceived there had always been adequate water available for irrigation in the past, while others felt there had been seasonal shortages. One-third of respondents perceived that some farmers were obtaining more or sometimes less water than others, which suggests there may have been some water distribution problems.

4.9.5 Financial, Institutional and Organisational Factors

4.9.5.1 Agricultural credit

All commercial farmers had obtained credit for farming inputs, mainly from the Ciskei Agricultural Bank. Only 37% of food plot holders were able to obtain credit from one or other source. Most commercial farmers were able to repay loans while the scheme was functioning, while 65% of food plot holders were unable to repay loans. The reasons given were simply "inadequate income".

4.9.5.2 Land tenure

The majority of commercial farmers (92%) and foodplot holders (80%) were dissatisfied with the present system of land tenure. The general perception was that there should be a

legal system of land tenure which would provide security. On being questioned on the size of unit, 54% of commercial farmers felt units should be larger, while this was the case with 67% of food plot holders feeling that present units were too small.

There were differences of opinion as to whether plot holders should be able to sell or lease plots to others. The majority of commercial farmers (79%) were against negotiability of land rights, while only 43% of food plot holders were of the same viewpoint. The reasons given for this point of view were that "we want to use the land ourselves", "it will lead to conflict" and "we did not pay for the land".

At the same time, in line with perceptions on the size of unit, the majority of FPHs (70%) and CFs (63%) said they would like to acquire more land.

4.9.5.3 Scheme management

The majority of respondents (82%) expressed satisfaction with the previous ULIMOCOR management. Reasons give for dissatisfaction included: "not explaining financial statements" "lack of transparency", "poor extension" and "debt load". When asked to rate the performance of previous management on a scale of 1-5, the majority of CFs (71%), and FPHs (59%) rated it as being good. Only a minority (15%) rated management performance as poor or very poor.

Both groups were almost equally divided on the issue as to whether farmers themselves could in the future manage their particular section of the scheme. Those with a negative perception felt they would still require outside assistance from officials of the Department of Agriculture or other management agents.

4.9.5.4 Farmers' committee

The majority of CFs (88%) and FPHs (74%) expressed satisfaction with their current Farmers Union local committees. The most important suggestion to improve farmers' representation was for the two farmer unions to amalgamate into one representative union. The majority of farmers in both groups appeared to be satisfied with communication between their unions and members, as well as with officials.

4.9.5.5 Extension Services

While only a minority of respondents were dissatisfied with the advice provided by extension workers on the scheme, a survey of extension workers (Refer 4.8) showed that they had shortcomings in their knowledge of irrigation techniques. Extension officers themselves expressed deficiencies in their own knowledge and competency. Respondents were divided on whether they preferred male or female extension officers. More than half preferred males while 40% were prepared to accept either gender.

4.9.5.6 Farmer training

The majority of CFs (58%) and FPHs (70%) felt that farmers were inadequately trained to fully participate in running the scheme. The greatest perceived need was for management training. Other needs were for training in technological aspects such as crop production, pest control and irrigation techniques. Individual respondents expressed the need for training in crop growing, scheme maintenance, marketing and irrigation techniques.

4.9.6 Socio-psychological Factors

4.9.6.1 Scheme objectives

The majority of respondents perceived that the most important objective in establishing the scheme was to improve livelihoods (88%). Next in order of importance was to produce crops all year round, provide employment and to provide food security. The most important expectation from the scheme was for improved income and food security as well as improved farming knowledge.

4.9.6.2 Scheme rehabilitation

Participants were unanimous that the scheme should be rehabilitated. Perceptions on the major needs to rehabilitate the scheme focused, in order of importance, on reconnecting electric power for irrigation pumps, providing fencing to exclude animals from irrigated areas, re-instituting management, provision of draught power, provision of credit for food plot holders, overcoming the salinity problem, as well as improved irrigation technology (draglines). Other issues mentioned were provision of Orange River water, improved domestic water supplies (boreholes) and farmer training.

4.9.6.3 Farmer participation

Participants were unanimous that they should play a greater role in general decision making on the scheme. This included water distribution, water allocation and scheme financing. It should be noted in 4.10.5 that farmers also perceived the need for further training to undertake these tasks.

4.9.6.4 Perceived problems

In line with perceptions on the needs for rehabilitating the scheme, the most important perceived problems which needed to be solved were reconnecting the water supply system, provision of draught power, restoring management, fencing off arable areas, improving irrigation technology and improved marketing.

4.9.6.5 Conflicts

The underlying conflict on the scheme was due to differences of opinion between the two farmers unions, EDAFU and EPAU. Other conflicts had arisen due to theft of crops, as well as minor issues such as repayment of loans and damage to equipment.

Respondents felt conflict problems could best be solved by negotiation and the formation of one farmers' union on the scheme. It was felt that the theft problem could be solved by hiring security.

4.9.6.6 Farm decision-making

The role of husband and wife jointly and wives in decision making showed similar patterns between CFs and FPHs (Table 4.14).

Table 4.14 Farm household decision-making, Tyefu irrigation scheme, 1998 (N=94)

Decision category	Husband		Husband + wife		Wife		Other	
	CFs %	FPHs%	CFs%	FPHs%	CFs%	FPHs%	CFs%	FPHs%
Crops to grow	29,2	32,9	37,5	35,7	25,0	27,1	8,3	4,3
Purchase of inputs	12,5	30,0	25,0	27,1	25,0	22,9	37,5	20,0
Household labour	16,7	25,7	45,9	44,3	33,3	25,7	4,2	4,3
Crop marketing	12,5	25,7	25,0	40,0	25,0	27,1	37,5	7,1
Household expenditure	16,7	28,6	45,8	42,8	37,5	25,7	-	2,9

The greater role of "others" in commercial farmer-decision making is explained by the role of management in providing inputs and marketing of baby carrots to the private sector.

4.9.6.7 Gender issues

The importance of wives in providing labour and in decision-making was discussed in 4.9.4.4 and 4.11.6. There were different perceptions on the manner in which the scheme had affected women. Some felt they now worked longer hours, had much heavier work and often had to work alone. Others perceived the scheme had provided more food and increased employment. Surprisingly, a large percentage felt there had been a greater amount of illness since the scheme started.

The majority felt that women previously had more grain residues to feed their chickens. Others felt they had become more dependent on their husbands. Respondents were divided as to whether wives had received more or less income since the scheme started.

4.10 VIABILITY ASSESSMENT

The viability of an irrigation scheme ultimately depends on the interaction of several factors. These include the cost of infrastructure, the physical potential, technology, markets, support services and management, as well as human resources.

It has been established that high pumping costs, as well as water quality in areas of the Great Fish River not served by the Orange River scheme are major constraints on the Ndlambe, Pikoli and Kalekeni sections, comprising 336ha. According to a recent survey (GibbAfrica, 1999), the capital cost of restoring the pumps will be approximately R2,425 million (R7262 ha). This translates to approximately R2650 per ha per annum (17% interest and redemption over 4 years). To this must be added pumping costs of R1050 per ha per annum assuming that all 336 ha are fully utilised. Taking into account water quality and the fact that the full irrigable area is unlikely to be utilised for some time, as well as future maintenance, salaries and operations, the viability of restoring the pumps in the long term is very marginal.

In the long term the only means of reducing water delivery costs and improving water quality, is to extend the pipeline from the Glen Boyd Dam to supply the aforementioned sections. The estimated cost of these works is approximately R15million. In addition, the sprinkler systems need to be renewed at an estimated cost of approximately R3,32 million (Joubert, J., 1998, personal communication).

Table 4.15 Estimated viability of rehabilitating Tyefu Irrigation Scheme (664ha), 1999

Capital cost	**Total**	**per ha**
Pipeline from Glen Boyd Dam	15 000 000,00	22 590,36
Sprinkler systems	3 320 000,00	5 000,00
Interest and capital redemption @ 17%*	3 132 720,00	4 717,95
Gross margin on crops**		
Vegetables + maize for sale (external)	4 218 392,00	6 353,00
Vegetables + maize for sale (internal)	5 223 688,00	7 867,00

* Redemption over 30 years
**Based on 60% maize (7 ton /ha) and 40% vegetables (carrots, cabbages, potatoes)

While there was no available data on previous crop yields, evidence showed that the scheme did contribute significantly (80-90%) to household food security. At the same time, observations showed that crop yields varied considerably and were below potential (van Averbeke *et al*, 1998).

Based on optimum yields of traditional maize and vegetable crops which will take some years to achieve, it is clear from Table 4.15 that if participants are required to fund the interest and redemption themselves, then rehabilitation of the scheme will involve a high degree of risk and will be economically non-viable.

The gross margin when maize is marketed locally or as "green mealies" is at least double that when maize is sold through formal marketing channels. In any event, because of lack of resources and the general poverty situation pertaining in the area, the majority of households

would not be able to afford to pay off interest and redemption unless traditional crops are replaced with high value permanent crops, such as citrus. Even if the interest and redemption are subsidised, the potential gross margin based on maize and vegetables would be approximately R31 468 for commercial farmers and between R1258 and R1966 per annum for food plot holders (Table 5.15). van Averbeke *et al* (1998) show a gross margin of R415 for food plot holders. In practice, however, due to human constraints, such as low levels of literacy, a preponderance of older people and low incomes, target incomes are unlikely to be achieved for a number of years.

Furthermore, in order for the scheme to achieve optimum target yields, support services, including inputs, credit, marketing and draught power, need to be provided. All of these are lacking in varying degrees at present.

In addition to capital costs of infrastructure, the Departments of Agriculture, Water Affairs and Forestry would need to budget for a facilitator and water bailiffs, until such time as Water User Associations (WUAs) have been adequately trained to take over the latter function.

There is undoubtedly a good potential for permanent and high return crops such as vegetables for processing as well as citrus. The latter does not lend itself to small-scale farming. Because of the need for economy in scale, the land tenure system would need to be amended to allow some form of co-operative production based on consolidation of units. The possibility of a 100ha citrus on land not presently utilised has already been evaluated.

The potential gross margin from navel oranges and soft citrus is in the region of R30 000 per hectare after 8 years. Establishment costs are approximately R46 000 per ha, excluding equipment costing approximately R12 000 per ha. A problem is bridging finance until the trees come into production at 4 years of age.

If the scheme is expanded beyond the present 664ha, the gross margins reflected in Table 4.15 become more favourable. It is important to emphasise that the gross margins shown in Table 4.15 assume a high standard of management of the scheme itself and by individual plot holders.

It is clear from the above that the scheme can only be considered for rehabilitation as a poverty relief measure. However, the cost : benefit of expenditure indicated in Table 4.15 needs to be weighed against other poverty relief measures.

4.11 CONCLUSIONS

- It is clear that from the outset the scheme was not economically viable. The government of the day agreed to the scheme as a means of poverty alleviation, albeit a very expensive means.
- It is clear that the rehabilitation of the scheme involves not only high costs but also a degree of risk in terms of ensuring sound management of the scheme, as well as in terms of individual farmers effectively utilising available crop production and irrigation techniques to achieve projected gross margins (Refer Table 4.15)

- There is no doubt that the scheme is a potential asset to the local community. It is in an area of extreme poverty that generally lacks resources.

- The scheme has the basic infrastructure and water supply in place. Many of the farmers are familiar with irrigation farming, especially the commercial farmers. A concern with the latter is the preponderance of farmers in the older age groups.

- It can be concluded that the high costs of electricity for pumping water from the Great Fish River are completely uneconomic at an estimated R1050/ha/annum. Alternative solutions to obtaining water for Ndlambe (160ha), Pikoli (120ha) and Kalikeni (15ha) need to be found (Refer recommendations).

- Much of the above ground irrigation equipment is in bad shape and needs to be upgraded.

- Data on crop production prior to closure of the scheme confirm that the scheme has been successful in improving food security and incomes, especially among commercial farmers. Suspension of electricity supplies due to shortage of funding has resulted in considerably increased poverty, especially on the three affected sections.

- The major crops of maize, cabbage and potatoes are well suited to the scheme. New crops being advocated are sugar beet and paprika. There has been virtually no integration of livestock with irrigated crops. Cattle and goats often cause damage to crops. There is clearly a need for further research to investigate alternative farming systems under on-farm conditions.

- There were definite shortcomings in knowledge and skills of extension workers to provide sound advice to farmers, as well as reinforce local leadership and participation (Refer 4.8).

- Commercial farmers have had easy access to credit for cash crops such as baby carrots. Food plot holders, except for Glenmore who have access to Trust funds, do not have adequate access to credit for inputs.

- Market outlets for surplus crops, input supplies and draught power are issues which need to be solved for the rehabilitation of the scheme.

- Leadership and management skills in the context of future management of the scheme are serious constraints and need to be developed and strengthened. Participants themselves perceived the need for greater participation and management of the scheme.

- The majority of participants in the scheme were dissatisfied with the present system of security of tenure, as well as the size of farming unit. This is a disincentive for farmers to invest in their plots.

- Farmers were generally in favour of water charges provided they were affordable.

- Current poverty conditions among households have reinforced the unanimous perception that ways and means need to be found to rehabilitate the scheme.

4.12 RECOMMENDATIONS

⇒ A general recommendation drawn from the conclusions above is that the scheme should be rehabilitated and restructured on the understanding that it is a poverty relief measure. Restructuring should be aimed at reducing costs and encouraging greater farmer commitment and participation in the running and maintenance of the scheme.

⇒ It should be recognised that initially advantages to the community will be more in the nature of social benefits in terms of social security for food plot holders. At the same time, the viability of commercial units needs to be increased to projected gross margins.

⇒ Recommended that consideration be given to investigating the expansion of the scheme in areas of moderate to moderately high soil potential. This will make the scheme more viable.

⇒ Before utilising any of the marginal and low potential soils these should be fully researched and investigated.

⇒ In order to reduce pumping costs, it is recommended that the pipe distribution system from the Glen Boyd Dam be extended to supply Ndlambe, Pikoli and Kalikeni with irrigation water. Approximately 12 kms of pipeline will be required to reach Ndlambe section and the Mankazana dam (Figure 2). The development would need to be implemented over a three year period This will largely solve the current problems of water quality on the 3 sections affected. This development will need to be negotiated with the Department of Water Affairs.

⇒ It is recommended that the present state of above ground irrigation equipment be carefully evaluated and upgraded. Minor changes are also needed to underground systems, and drag line sprinklers are needed to replace current sprinkler systems. The estimated cost is in the region of R5000 per hectare - R3,32 million overall.

⇒ It is recommended that a skilled facilitator be appointed to assist in restructuring local institutions together with the Restructuring Authority and the newly formed committee of ten comprising the two farmers associations. It would be a distinct advantage if the two farmers associations were to amalgamate.

⇒ It is recommended that a Water Users Association (WUA) be established for the scheme as a whole. The WUA as a legal body with its own constitution, should be able to take over scheme assets, take out collective loans, operate accounts and institute by-laws enforceable by its members. The WUA will be responsible for all

water and maintenance matters to field edge related to the scheme as a whole. It would also be responsible for arranging input supplies, draught power and marketing. Ideally, each of the six sections should be represented on the WUA. More important is to develop the ability of members in decision making and management.

⇒ It is recommended that in the initial stages the scheme be managed jointly by the WUA and a suitable Government appointed agent, until such time as the WUA is able to operate effectively on its own.

⇒ It is recommended that Block Committees be established for each of the six sections of Kalikeni, Pikoli, Ndlambe, Ndwayana, Glenmore and Committees. The Block committees will be responsible for water management and maintenance from field edge, as well as extension services, ploughing services, input supplies, crop spraying and related matters. As with the WUA, Block Committees should be legally constituted with clear powers and terms of reference. It is important that Associations participate from the pre-planning stage onwards.

⇒ Training of the WUA and Block Committees is vital for successful restructuring. Recommended that the Facilitator, in co-operation with local committees and the Department of Agriculture, arrange for on-the-job training of members in accordance with the objectives and needs of effectively managing the scheme.

⇒ Recommended that the Facilitator discuss and finalise acceptable land tenure reforms with the WUA and Block Committees, which will provide security of tenure to all participants in the scheme. The Department of Land Affairs will need to play a role in finalising this issue.

⇒ Recommended that the issue of water charges be negotiated with the Department of Water Affairs aimed at consensus on affordable rates in terms of the scheme objectives.Further development should only take place once the issue of water operating costs and water charges have been finalised.

⇒ It is recommended that the Department of Agriculture in co-operation with the Agricutural Reseach Council and local structures, plan and implement on-farm research to establish suitable farming systems for the scheme. This should include possible integration of livestock.

⇒ It is further recommended that the WUA institute market research in co-operation with agricultural economists of the Department of Agriculture or their nominees, aimed at assessing markets for agreed production systems. It is important to establish marketing partnerships with wholesalers and retailers for scheme products

⇒ It is recommended that the WUA negotiate input loans for food plot holders through the Land Bank.

⇒ Extension staff need to be upgraded by on-the-job training in crop production, irrigation techniques and farm management. Training should be aimed at improving their competence to provide effective advice and skills training for farmers. If the Department does not have personnel available, training could be contracted to the Agricultural Research Council or the University of Fort Hare.

CHAPTER 5

SEKGAKGAPENG IRRIGATION SCHEME

5.1 GENERAL DESCRIPTION AND HISTORICAL BACKGROUND

The 28ha centre pivot scheme was established in 1984 by the Department of Agriculture in consultation with the Mokopane Local Government. The scheme was very much of a"top down" nature. The authorities perceived an opportunity to use water from the Mogalakwena River to produce food for the participants as well as the local Sekgakgapeng community.

After an agreement between the Department and the Local Government, a meeting was held with the Sekgakgapeng community to introduce the idea of establishing an irrigation scheme. Since the scheme was to be established on land already allocated to individuals, it was decided that the land holders be given first option to participate in the scheme. Because it had been decided that those allocated irrigation plots had to farm full time, many of the original plot holders declined to participate. It was then decided to call for volunteers among the community who were interested in participating in the project. No data whatsoever on this scheme was available from the Department of Agriculture.

5.2 PROBLEM DEFINITION

Because of pressures from non-participants in the Sekgakgapeng community, possibly due to the clamour for additional residential land, the scheme was sabotaged. The centre pivot pump and tyres were damaged so that it could no longer be used. Following this, the Department decided to disconnect and remove the pumps and motors from the boreholes which were put down to supplement water from the river during times of drought. A further problem was caused by water from at least two of the boreholes having a high saline content.

5.3 PHYSICAL FACTORS

5.3.1 Geographical situation

The scheme is situated approximately 10kms from Potgietersrust and adjacent to Sekgakgapeng Township, the boundaries of which adjoin the Potgietersrust Municipal area.

5.3.2 Climate

5.3.2.1 Rainfall

Average rainfall figures in mms for 28 years are given in Table 5.1 below:

Table 5.1 Average mean monthly rainfall in mm, Sekgakgapeng irrigation scheme

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.	Total
114,5	82,4	67,7	34,3	8,4	6,2	2,1	6,5	18,5	43,8	88,6	102,4	575,4

Mid-season droughts often occur in the area. Supplementary irrigation in summer is therefore essential to achieve optimum crop yields.

5.3.2.2 Temperatures

Average temperatures vary from approximately 23° in the summer rainfall months of November to February to 13 - 14° in the winter months of June - July.

Table 5.2 Mean monthly temperatures, °C, Sekgakgapeng irrigation scheme.

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
24,0	23,4	22,1	19,6	16,4	13,5	13,7	16,3	20,0	21,9	22,5	23,4	19,7

Maximum temperatures in summer are around 29°C from October to March, while minimum temperatures in June and July are about 2°C. Occasional frosts may occur from early June to early August. There is about a 30% chance of moderate frosts occurring. Evapotranspiration in summer is generally high.

5.3.3 Soils

Seven soil pits were dug over the 28ha area. Soils are of the Hutton form. Soil profiles were fairly structureless with different consistencies. It is thus necessary to build up the soil structure with cover crops and mulching. The pH value of the top soil and sub-soil was within the range of most crops. Potassium and phosphorus levels were low, while calcium levels were low to medium. Both the top soil and sub-soil were found to be non-saline, but the sodium content was found to be at a level where it could affect crop growth and the physical condition of the soil. This can be remedied by applying gypsum, which may only be justified in high value crops.

5.3.4 Topography

The scheme is situated at an altitude of 1116 metres above sea level at latitude 24°11' South, longitude 29°01' East. The topography of the arable area is gently sloping towards the river.

5.3.5 Water resources

The original water supply for the centre pivot was from pumping from the large vlei area in the Mogalakwena River (Figure 3). During a period of severe drought six boreholes

were sunk, two near the present pump station and two on the northern perimeter of the township (Figure 3). The boreholes near the river were found to be saline, whereas those on the perimeter of the township had low salinity. The idea was to mix the water from the saline and non-saline boreholes by pumping from both sources into a reservoir, from where it was pumped to the centre pivot. It was not possible to adequately test the boreholes because the motors, and in some cases the pumps, had been removed. However, historical evidence suggests there is adequate water for at least 28ha under irrigation.

5.3.6 Domestic water supplies

Apparently no communal domestic water supply system has been planned for the Makgakgabeng township, with 2060 households and an estimated population of 14490 persons. A number of households have put down their own boreholes and sell water to other residents

5.4. INFRASTRUCTURE

5.4.1 General infrastructure

Because of its close proximity to Potgietersrust the irrigation scheme is well served by infrastructure such as roads, schools, electricity and retail outlets.

5.4.2 Farming structures

Other than the irrigation scheme itself, the only infrastructure is an implement shed and storage facilities adjacent to the scheme. The irrigation area is fenced off, but the fencing is in need of repair.

5.4.3 The irrigation scheme

The layout of the irrigation scheme is shown in Figure 3. The water reticulation system was described in 5.3.5 above. Each of the 14 participants have been allocated a triangular piece of land 2ha in extent. A centre pivot dictates that all participants need to be on the same cropping system, which in this case comprised sunflowers, maize, cotton and soya beans in summer and wheat in winter. No reliable data on previous crop yields were available.

5.5 LOCAL INSTITUTIONS

The irrigation participants have an elected committee of 7 members, including 2 women. Besides the tribal authority, there are a number of other institutions concerned with governance in the Sekgakgabeng area. These include SANCO, the Greater Potgietersrust TLC and the Community Development forum. There are a number of other organisations

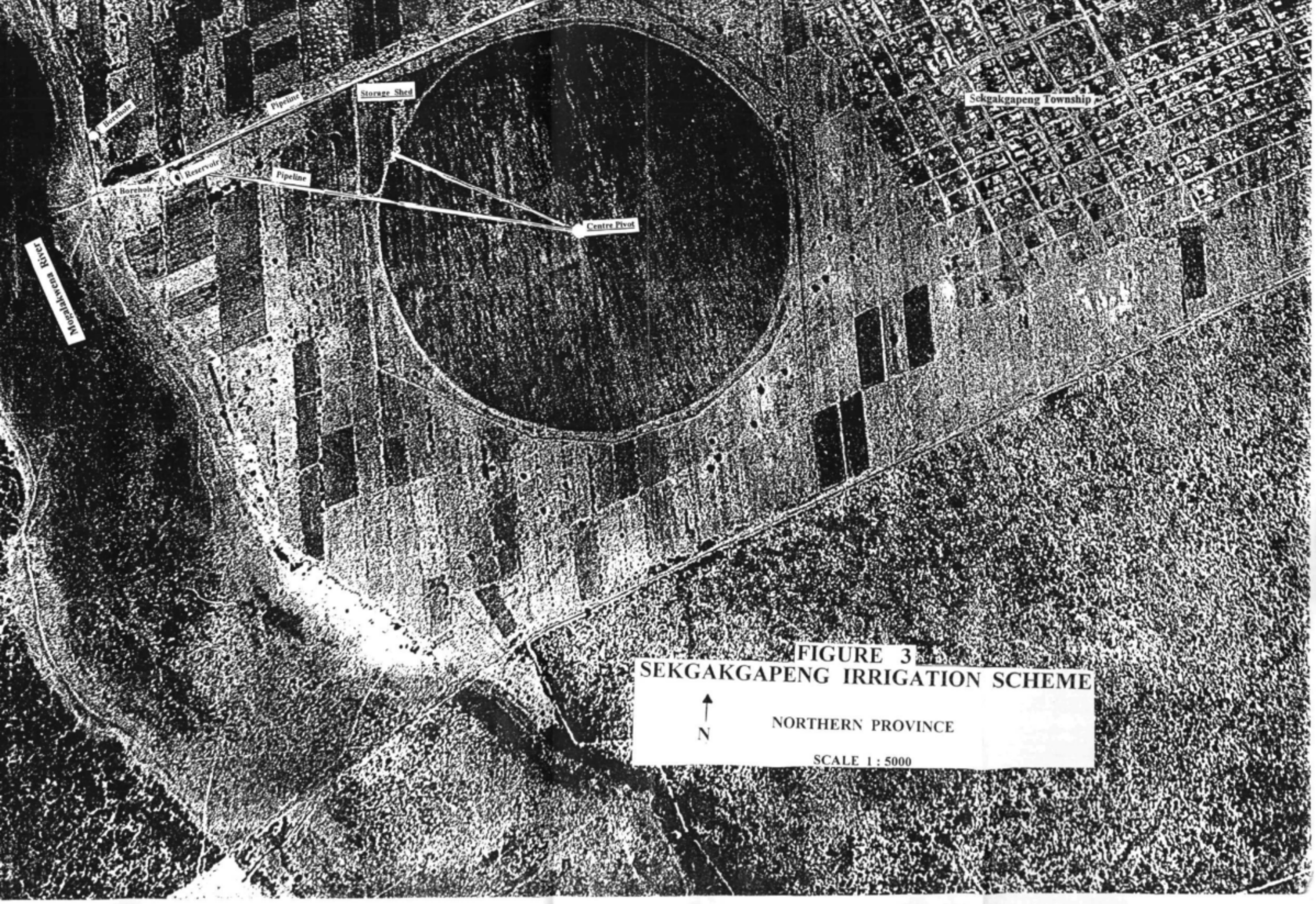


FIGURE 3

SEKGAKGAPENG IRRIGATION SCHEME

NORTHERN PROVINCE

SCALE 1 : 5000

dealing with specific fields of interest such as women's groups, youth against crime and the community policing forum.

5.6. COMMUNITY PERCEPTIONS OF THE SCHEME

Structured group interviews were held with the following organisations:

- Traditional Tribal Authority councillors
- SANCO-Sekgakapeng
- Greater Potgietersrust TLC
- Community Development Forum
- Sekgakapeng Youth Against Crime
- Sekgakapeng Policing Forum

Since all the farming participants were interviewed individually (Refer 5.8) and the writer had already held informal discussions with the Farmers' Committee, it was not considered necessary to interview the farmers as a group. What follows is a summary of the perceptions of non-participants in the scheme.

5.6.1 The scheme

The consensus among groups was that the scheme was established to produce food for sale locally, to provide employment to non-participants, as well as to train farmers in irrigation farming.

Groups were divided on the benefits which had accrued to participants. The majority perceived that only farmers had benefited financially and they had received some farmer training, while a minority felt there had been no direct benefits. On the question of improved living standards, the majority felt only participants had benefited. As far as benefits to the area as a whole are concerned, it was perceived that other than providing some employment, there had been no real benefits to the community.

5.6.2 Consultation

The majority were of the opinion that the Tribal Authority had been consulted about the development of the scheme, while others felt that only those affected had been consulted. Groups were unanimous that plots had only been allocated to former plot holders, which was a cause of dissatisfaction among the community. It was felt that plots should be offered to other interested people in the community. One idea put forward by the groups was that participants should participate in the scheme in alternate years, thereby spreading the benefit to others. All groups were of the opinion that many other households in the community would like to participate in the scheme.

5.6.3 Land tenure

Groups were unanimous that the *status quo* should be maintained on land rights i.e. the right to occupy.

5.6.4 Management

All groups perceived that management of the scheme by the Department of Agriculture was unsatisfactory. This was probably due to previous lack of consultation and participation. It was felt that there was a need for greater community involvement in management, greater collaboration with the Tribal Authority, as well as the need for training participants.

5.6.5 Conflicts

Most of the conflicts appeared to revolve around land issues, such as agreement on exchanging plots, division of land, use of abandoned lands and allocation of lands to those who wished to return. Fines for livestock was also an issue of contention.

5.6.6 Farmers' committee

Groups were divided on the issue as to whether the Farmers' Committee were doing a good job. Those who dissented felt that a new committee should be formed incorporating political and development organisations.

5.6.7 Role of women

Groups were unanimous that women had a vital role to play on the scheme.

5.6.8 Political support

The majority of respondents felt there was inadequate political support for the scheme, citing lack of community involvement as a major issue.

5.6.9 Future development

Some groups were of the opinion that a Facilitator should be employed to solve the various issues involved in rehabilitating the scheme, as well as ensuring greater community participation. It goes without saying that it was felt that the pumps, irrigation systems, and fencing should be repaired. It was felt that some government subsidy was necessary to make the scheme viable. Other suggestions hinged around greater community participation in the management of the scheme.

5.6.10 Poverty alleviation

Groups were requested to put forward their ideas for alleviating poverty in the area. Suggestions included farmer training, employment opportunities, creation of small agro-industries, involvement of NGOs in programmes, expand food plots, start new projects, poultry units, establish market stalls and integration of irrigation with area development.

5.6.11 Community services

Perceptions of services required by the community included improvement of water supplies, electricity, a health care centre, improved telecommunications, small industries, training and development of local institutions, market stalls,a recreation hall, pre-schools and more retail outlets.

5.6.12 Scheme rehabilitation

All groups were unanimous that the scheme should be rehabilitated. Suggestions on the needs to rehabilitate the scheme included election of a new committee, greater community participation, repairing of pumps, participation in alternate years, farmer training and improved extension services.

5.7. SCHEME PARTICIPANTS

The following are the results of a questionnaire survey conducted on all participants during 1998:

5.7.1 Introduction

The first plots were allocated in 1984 and 1985. In 1994 and 1998 four of the original plot holders were replaced by other family members. The majority of plots were allocated to male heads of households and the remainder (21%) to female headed households.

5.7.2 Personal characteristics

One in five (21%) of heads of households were widowed. The average age of participants was 57 years (Table 5.3). Older participants do not have the same motivation to improve productivity as is the case with younger participants who have greater financial commitments.

Table 5.3 Personal characteristics of heads of households, Sekgakgapeng irrigation scheme, 1998, (N = 14)

Characteristic	No.	%
Marital status		
Married	11	78,6
Widowed	3	21,4
Age group		
<40 years	2	14,3
41 - 50	2	14,3
51 - 60	6	42,6
> 60 years	4	28,6
Education level (years)		
No education	8	56,8
0 - 4 years	1	7,1
5 - 6 years	2	14,3
7 - 8 years	2	14,3
> 8 years	1	7,1

Only 36 per cent of respondents can be regarded as having any degree of literacy, which is clearly a constraint in terms of numeracy and communication. The average family size of those living at home was 6,8 persons. An additional 0,9 were living away from home.

5.7.3 Socio-economic characteristics

Only two (14%) respondents were in employment. Four respondents (29%) had sons and two (14%) had daughters in employment, which to some extent probably supplemented household income (Table 5.4)

Table 5.4 Socio-economic characteristics of households, Sekgakgapeng irrigation scheme,1998 (N = 14)

Characteristic	No.	%
Employed	2	14,3
Pensioners	8	57,1
Annual savings No.	1	7,3
Household expenditure (R per month)		R 965.00 (S.D. 735)
Expenditure on food (R per month)		R 625.70 (S.D. 549)

Pensions made a significant contribution to overall household income. Eight households (57%) were in receipt of pensions, both husband and wife in three cases. On average,

39% of household income was derived from pensions. Since only one household was able to save any money, household expenditure more or less equates with household income.

A general conclusion from the data was that 65% of participants were living below the poverty datum line of R1100 per month for a family of 6 persons (Whiteford, Posel and Ketlatwang, 1995). Average expenditure on food was 65% of total expenditure (Table 5.4)
As the scheme is now defunct, the only income from agriculture was derived from dryland crops, mainly maize. While 57% of farmers maintained the family had enough food before the scheme closed, this was the case of only 14% today.

5.7.4 Agricultural production

5.7.4.1 Crops

The previous contribution of crops from the scheme to household income prior to the scheme closing is shown in Table 5.5.

Table 5.5 Average gross income per 2 ha plot from crops prior to 1996 (N = 14)

Crop	Mean income (R)	S^2
Maize	701	893
Cotton	2 082	1318
Sunflowers	2 381	1046
Soyabeans	459	518
Wheat	93	307
TOTAL	**5 716**	

Allowing for production costs, it is clear that the scheme did make a major contribution to household income. A disadvantage of a centre pivot system is that farmers are obliged to adhere to the same farming system. With close proximity to a large market vegetables would have given much higher returns. The estimated average value of dryland crops in 1997/98 was only R293 per plot.

5.7.4.2 Livestock

Livestock made no significant contribution to household income. Only one household owned cattle, two owned goats and only one owned sheep. Poultry and pigs were of no significance in the household economy.

5.7.4.3 Implements, vehicles and tools

Table 5.6 Household ownership of vehicles, implements and tools, 1998 (N = 14)

Implement/vehicles/tools	No.	%
Tractor	2	14,3
Bicycle	4	28,6
Bakkie	4	28,6
Motor car	1	7,1
Ox planter	6	42,9
Trailer	1	7,1
Hoes	7	50,0
Spades	6	42,9
Forks	5	35,7

Probably due to the shortage of animal draught power, none of the farmers owned ox ploughs or cultivators. They were also short of garden tools. The fact that two of the farmers owned tractors means that they are able to undertake contract ploughing for others.

5.7.4.4 Labour

Irrigation farming was mainly carried out jointly by husband and wife or the wife alone. Being a centre pivot, irrigation scheduling was undertaken by management.

Table 5.7 Household labour inputs on various tasks, 1998 (N = 14)

Task	Husband %	Husband + wife %	Wife %	Other %
Planting	14,3	57,2	21,4	7,1
Irrigating	-	-	-	100,0*
Weed control	7,1	42,9	42,9	7,1
Harvesting	7,1	42,9	42,9	7,1
Sale of crops	7,1	57,1	28,7	7,1

* Carried out by scheme management

Farmers perceived weed control and secondly harvesting, as requiring the highest labour input. The majority of farmers hired local labour for weed control and harvesting. The average number of hired labour days per annum was 52,6 (S^2 31,2).

5.7.4.5 Irrigation systems

The majority of irrigators (71%) were not satisfied with the centre pivot system. This was because there were unable to have free choice of crops, as well as breakdowns of the system, resulting in inadequate irrigation. They preferred sprinkler or various types of pipeline irrigation.

5.7.4.6 Water quality and charges

No data are available on pumping and distribution of costs. All farmers were willing to pay for water provided it was reasonable. Most farmers said water was applied every seven days. All farmers were concerned about the quality of water (salinity). Farmers were divided on the issue as to whether there had always been enough water for irrigation in the past. As mentioned earlier, in severe droughts pumping water from the river had to be supplemented by drilling boreholes.

5.7.5 Financial, Institutional and Organisational Factors

5.7.5.1 Agricultural credit

The majority of farmers (57%) had previously borrowed money for inputs and were able to repay loans from crop proceeds.

5.7.5.2 Land tenure

The majority of farmers (79%) were dissatisfied with the present system of land tenure. This perception appeared to be more in the nature of protection of the scheme from theft and damage than security of tenure *per se*. The majority (79%) felt the size of plot (2,0ha) was large enough, even though they stated they would like to have more land. Farmers were not in favour of selling or leasing land to others, mainly because it was regarded as being allocated free of charge. Subsequent discussions by the writer with the farmers committee indicated that in view of the conflict situation, they would be prepared to give up half the irrigable land to be allocated as food plots to interested community members.

5.7.5.3 Scheme management

The majority of farmers (93%) were satisfied with the previous scheme management. This was in contrast to the feelings of non-participants (Refer 6.5). When asked to rate the performance of previous management on a scale of 1-4, the majority (79%) rated management as either good or very good. The majority of farmers (71%) felt that they could manage the scheme themselves under the guidance of extension officers.

5.7.5.4 Farmers' committee

Seeing that half the farmers served on the committee, it is not surprising that in all but one case, farmers were satisfied with the performance of their committee. There was unanimous satisfaction on the communication between farmers themselves and between farmers and management.

5.7.5.5 Extension services

The finding that farmers preferred to go to the extension officer for advice, and in a few cases the chairman, suggests that the local extension officer has good credibility with the farmers. While the majority of farmers (57%) preferred a male extension officer, the remainder were prepared to accept either gender.

5.7.5.6 Farmer training

The majority of farmers (64%) felt they were adequately trained in irrigation farming, while others expressed the need for training in management and crop production, including pest control.

5.7.6 Socio-Psychological Factors

5.7.6.1 Scheme objectives

Farmers perceived that the scheme objective was to improve their livelihood through producing crops all year round. It was generally felt that all farmers had benefited from the scheme through producing food and being able to sell crops to boost household income.

5.7.6.2 Scheme rehabilitation

Participants were unanimous that the scheme should be rehabilitated. The major needs to rehabilitate the scheme hinged on making the boreholes functional, repairing the fencing, and negotiations with the community concerning future participation in the scheme, including irrigation technology to be used. It was felt that the issue of water quality, draught power and farm inputs should be addressed.

5.7.6.3 Farmer participation

Farmers were unanimous that they should play a greater role in decision-making on the scheme. It was felt that water distribution and water allocations should remain with the Water Bailiff for the time being.

5.7.6.4 Perceived problems

In line with perceptions of rehabilitating the scheme, farmers felt the most important problems to be tackled included an assured water supply, water quality, adequate fencing, provision of draught power, repair of the irrigation system and theft prevention.

5.7.6.5 Conflicts

Farmers perceived the most important conflict problems concerned theft of crops and damage to irrigation equipment. It was felt that these problems could best be tackled through negotiations and by hiring security.

5.7.6.6 Farm decision-making

Table 5.8 Farmer decision-making, Sekgakapeng, 1998 (N = 14)

Decision category	Husband %	Husband/wife %	Wife %	Others %
Crops to grow	28,6	42,9	14,3	14,3
Purchase of inputs	28,6	42,9	14,3	14,3
Household labour	28,6	50,0	14,3	7,1
Crop marketing	28,6	50,0	14,3	7,1
Household expenditure	28,6	50,0	14,3	7,1

There was little variation in the pattern of decision-making on various aspects of farming. In most cases decisions were made jointly between husband and wife, with the wife as sole decision-maker in the absence of the husband. Others involved were usually the family members or in some instances, the extension officer.

5.7.6.7 Gender issues

Generally speaking it was felt that the irrigation scheme had involved women in working longer hours, having less access to land and becoming more dependent on their husbands.

5.8 VIABILITY ASSESSMENT

The viability of the scheme is largely dependent on satisfactory tests of the water quantity and quality. The latter is suspect in two of the six boreholes supplying the scheme.

The centre pivot has been sabotaged and is out of action, it has been in operation for about 12 years. The life of the equipment is normally about 15 years which indicates heavy equipment costs in the future. Communal centre-pivot systems do not allow farmers free choice of cropping systems, besides which this technology does not lend itself to the development of food lots to serve the local community. Future development should be based on a quick coupling dragline system for the 14 communal farmers, and minisprinklers for the foodplot area.

There is a large potential market for fresh vegetables in nearby Potgietersrust, as well as in the Sekgakgapeng township. Potential gross margins shown in Table 5.9 could be increased by approximately R2000 per ha, by including a winter crop, such as wheat.

Gross margins achieved prior to closure of the scheme were less than half the potential, if high return vegetable crops are included in the cropping programmes.

Table 5.9 Viability assessment of converting to dragline sprinkler system

	Capital cost	**per ha(28)**
Capital cost*		
Quick coupling dragline system -		
21ha @ R10 000	210 000.00	
Mini-sprinklers 7ha	30 000.00	
	240 000.00	**8571.42**
Interest and redemption @ 17% over		
30 years	**41 040.00**	**1465.71**
Gross Margin**		
Vegetables + maize for sale (external)	177 884.00	6353.00
Vegetables + maize for sale (internal)	220 276.00	7867.00

*Based on 7ha community garden and 21ha of commercial plots.
** Based on 60% maize and 40% vegetables (carrots, cabbage, potatoes).

Because it is a small scheme, the potential income justifies payment of an annual interest and redemption charge. However, because of the poverty situation pertaining in the area, individual farmers would be unable to afford the capital cost and annual interest and redemption of rehabilitation, which would require a subsidy from Government.

It should be borne in mind that the potential gross margins shown in Table 5.9 will only be achieved through a concerted programme of skills training of participants and may take some years to achieve.

For sustained viability it is important that the Department of Agriculture and Water Affairs reach agreement with a Water Users Association for training of participants to take over the scheme at an early date.

It will also be important to strengthen extension services, as well as establish an organised marketing system.

5.9 CONCLUSIONS

The following general conclusions can be drawn from this case study:-

- Although there was prior consultation with local government structures, the design of the scheme was essentially a "top down" one.

- It appears that reliability and quality of water supplies was not adequately investigated in the initial planning stage. This has ultimately resulted in salinity problems.

- A major reason for the collapse of the scheme due to sabotage of the irrigation equipment, was the complete lack of integration of the scheme into the development of the Sekgakgapeng community. This ultimately resulted in unfavourable attitudes from an element of the local community, probably due to pressure on the land.

- Results of the study show that from an agricultural production point of view the scheme was successful in supplementing household income and increasing food production. Closure of the scheme has resulted in the majority of participants being in varying degrees of poverty.

- It can be concluded that the scheme is a potential asset to the community in supplying vegetables to the local community as well as to Potgietersrust.

- Both farmers and representative groups of the community were unanimous that the scheme should be rehabilitated. To be successful this would require greater overall community participation, including representation on the local committee, as well as extension and training.

- The centre pivot system has high operational and maintenance costs. It requires a mono-cultural farming system requiring integrated planning of operations. However, since the system is in place, it may not be possible to completely change the system in the short term. However, if funding is available it would be to the advantage of individual farmers to change over to a sprinkler system.

- The scheme has the advantage that the basic infrastructure and water supply is in place. Farmers are familiar with irrigation farming and have developed some basic skills, which can be further developed through on-farm extension and training.

- In small schemes such as Sekgakgapeng farmers should ultimately be able to manage the scheme themselves, including resource use and mobilisation of the whole system under guidance of irrigation specialists. Indeed the farmers themselves were very positive in this approach.

- There is a need for a change in bureaucratic procedures in a decentralised direction if increased farmer and community participation is to succeed.

- A recent survey revealed that initially at least 23 households in Sekgakgapeng township would be interested in participating in the scheme based on 0,10ha plots.

5.11 RECOMMENDATIONS

⇒ Since the infrastructure is already in place, it is recommended that the scheme be rehabilitated in the sense of renovation, as well as modification to meet new criteria as suggested below.

⇒ Before considering the rehabilitation of the scheme, it is important to establish both the quality and quantity of water available from the present 6 boreholes, with special reference to salinity.

⇒ In order to assist the community in rehabilitating and modifying the scheme, it is recommended that initially a skilled facilitator be appointed to assist the community in decision-making and management of the scheme.

⇒ It is recommended that negotiations be instituted with local structures for the formation of a new committee representing present farmers and the community. The new committee should be directly involved in planning the rehabilitation of the scheme.

⇒ If the community is to manage the scheme, the new committee needs to be incorporated in a legal body which can take over the infrastructure, borrow money, operate an account and institute by-laws enforceable on its members. Rehabilitation needs to be based on making a contribution to rehabilitating the scheme in cash or kind, as well as a firm agreement to maintain and run the scheme.

⇒ The new committee should ascertain from the community, the number of households who are genuinely interested in participating in foodplots on the scheme on a sustained basis. Foodplots can become commercially orientated if participants are keen and enthusiastic.

⇒ Initially the facilitator and irrigation specialists should assist the new committee in planning and implementation of the scheme rehabilitation.

⇒ Before any implementation can take place, the quantity and quality of water in the six boreholes needs to be thoroughly tested and analysed to ensure minimum salinity. Water quality needs to be regularly monitored.

⇒ It is recommended that the possibility of partially using the two boreholes on the northern perimeter of Sekgakgapeng township to supply communal water to the township be fully investigated. This would provide further integration of the scheme into development of the community.

⇒ It is recommended that the present 14 farmers reduce their holdings to 1-1½ ha each, depending on the demand from the community for foodplots. It is recommended that

the 14 farmers and prospective foodplot holders become share holders in a Community Property Association with a conditional long-term lease of the irrigable land and equipment from the State.

⇒ It is recommended that the centre pivot be replaced by a quick coupling dragline sprinkler system on the 21ha of commercial plots. A solid-set scheme using mini-sprinklers on a fixed 15 x 12m spacing with individuals having control over their own laterals by means of a ball valve at field edge is recommended for the food plot section (Scott, 1998a, personal communication). The total estimated capital cost is R240 000 (Table 5.8). If funding cannot be obtained immediately then the centre pivot will need to be repaired at an estimated cost of R10 000.

⇒ Paying for water and services will encourage a constructive attitude to management and maintenance of the scheme. It is recommended that the Department of Water Affairs negotiate with the community in deciding appropriate charges, in accordance with the scheme objectives and the ability of farmers to pay.

⇒ A major complaint on the scheme concerned theft of produce. This will largely be overcome once the community have a real stake in the success of the scheme. Present fencing around the scheme can be repaired at a fairly nominal cost. This is a task the new committee should undertake themselves.

⇒ New participants in the proposed communal garden may require initial loans for inputs. It is recommended that the new committee avail themselves of the Land Bank's new step-up loan of R250.

⇒ The scheme is unlikely to succeed without training for those responsible for managing the scheme and the participants themselves. Recommended that the new committee institute on-site extension and training programmes aimed at skills for operating the scheme and irrigated crop production.

⇒ Finally, it may be necessary for a subsidy or loan from government to kick-start the rehabilitation of the scheme.

CHAPTER 6

BULULWANE IRRIGATION SCHEME

6.1. GENERAL DESCRIPTION : HISTORICAL BACKGROUND

The Bululwane Irrigation Scheme established some 33 years ago is located in the Nongoma District, approximately 30kms from Nongoma itself. The scheme falls under the USUTHU Tribal Authority. King Goodwill Zwelithini has a palace nearby and also has a 1.2ha holding on the scheme.The scheme is situated north-east of the confluence of the Bululwane and Esikwebezi rivers.

Apparently King Goodwill Zwelithini's father, King Cyprian Rhekuzulu, requested the Government to establish the scheme in 1958 on land already under dryland crops. During 1960/61 roads providing access to the scheme were constructed by employing local labour. The scheme was eventually completed in 1965. Initially, only about 20 farmers were involved on Block 1. By 1967 all the blocks were allocated to approximately 340 farmers. Since 1980 farmers have experienced problems with draught power. There are 10 blocks on the irrigation scheme (Figure 4), involving farmers from Dengeni, Mhambuma, Phenyane and Kohlokolo sub-wards. Since the scheme was settled a number of other family members have become involved in the scheme.

6.2 PROBLEM DEFINITION

The following are some of the current problems on the scheme:

- Insufficient funds to clear the main storage dam of silt, as well as to maintain canals.
- A proportion of beds need to be levelled by a land plane if flood irrigation is to be practised efficiently.
- Approximately 80% of the 345ha is not being utilised due to a combination of lack of motivation and lack of resources.
- Lack of draught power. There are 4 tractors on the scheme, all of which were reported to be out of order.
- Crop yields are well below potential due to lack of inputs, inefficient irrigation, inadequate draught power and lack of knowledge.
- Marginal suitability of some soils
- Lack of participation by farmers in the maintenance and running of the scheme.

- Local structures and farmers require training in management, technology, and irrigation technique.

- Extension staff need training in irrigation techniques and crop management.

6.3 PHYSICAL FACTORS

6.3.1 Climate

The scheme is situated in the riverine and Interior Lowland bioclimatic region (Thorington- Smith, Rosenberg and McCrystal,1978).

6.3.1.1 Rainfall

The figures in Table 6.1 represent the average mean monthly rainfall (mm).

Table 6.1 Mean monthly rainfall, Bululwane irrigation scheme.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
154	140	84	67	21	4	8	19	48	80	105	104	834

The mean monthly evaporation (Class A pan) is estimated at 7,857mm per day.

6.3.1.2 Temperatures

Average mean monthly temperatures are shown in Table 6.2

Table 6.2 Average daily mean monthly temperatures, Bululwane irrigation scheme.

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
22,7	23,1	21,9	20,15	18,6	16,8	16,5	17,5	18,7	19,7	23,9	22,3	19,9

The maximum summer temperatures are in the region of 22 to 27 degrees C, while minimum temperatures in June/July are in the region of 11 degrees C. The area is thus hot in summer, mild to warm in winter, with practically no risk of frost.

6.3.2 Soils

Various soil types are found in the irrigable areas. Seventeen dominant and 8 sub dominant soil series form an intricate pattern. Generally speaking these soils can be divided into two broad groups : (1) clays and loams (Approx 75%) developed mainly on parent materials from Dwykatillite and Lower Ecca shales, and (2) loams and soils (approximately 25%) developed in alluvium. A full description of soils is available (CAPROS,1980).

GENERAL LEGEND

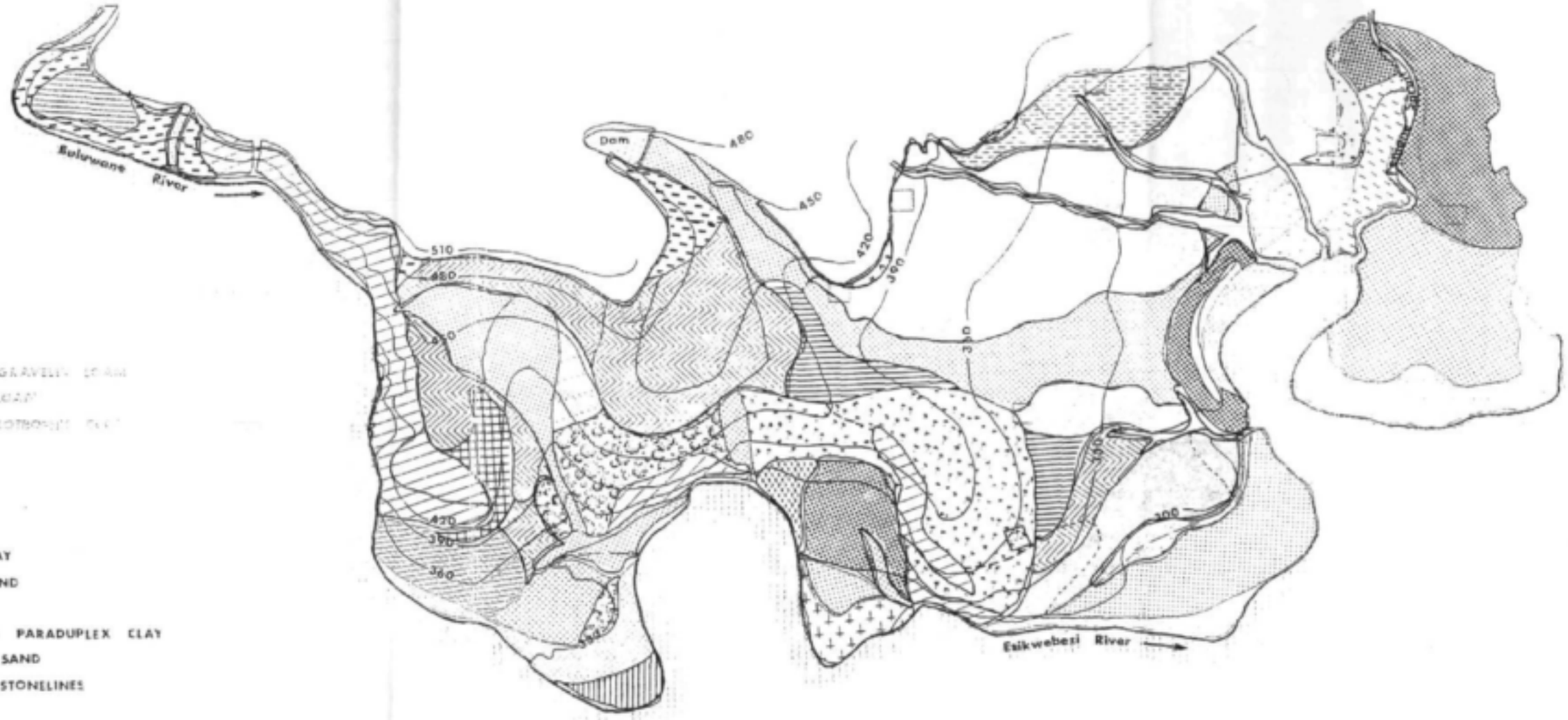
EXISTING STORAGE DAM

EXISTING LEIDAM

EXISTING CANAL

SOIL LEGEND

SOIL	DOMINANT SERIES	DESCRIPTION
		IRRIGATION SUITABILITY HIGH
		VERY DEEP LOAM
		VERY DEEP LOAM
		IRRIGATION SUITABILITY MODERATE
		DEEP MELANIC CLAY
		VERY DEEP STRATIFIED GRAVELLY LOAM
		VERY DEEP STRATIFIED LOAM
		VERY DEEP ARTIFICIAL MESOTROPHIC CLAY
		IRRIGATION SUITABILITY LOW
	WEENEN	DEEP MELANIC LOAM
	BONHEIM	DEEP MELANIC CLAY
	TAMRANKULU	DEEP MELANIC CLAY
	SIBASA	DEEP FERRUGENOUS CLAY
	LEVUBA	VERY DEEP MEDIUM SAND
	WILLIAMSON	SHALLOW LOAM
	CRAVEN	VERY DEEP CALCAREOUS PARADUPLEX CLAY
	DUNDEE	VERY DEEP STRATIFIED SAND
	SAINTFAITHS	SHALLOW CLAY WITH STONELINES
	IRRIGATION	SUITABILITY SPECIAL
	RENSBURG	DEEP VERTIC CLAY
	IRRIGATION	SUITABILITY NONE
	RENSBURG	DEEP VERTIC CLAY – HIGH WATER LEVEL
	SIBASA	MODERATELY DEEP FERRUGENOUS CLAY
	CHINYIKA	DEEP MELANIC CLAY
	CRAVEN	VERY DEEP CALCAREOUS PARADUPLEX CLAY
	ALBANY	VERY DEEP FERRUGENOUS LOAM – HIGH WATER LEVEL
	MISPAH	VERY SHALLOW CLAY
	MISPAH	VERY SHALLOW LOAM
		SHALLOW AND STONEY



SCALE 1 : 20 000

FIGURE 4 DETAILED SOIL SURVEY : BULULWANE IRRIGATION SCHEME

KWAZULU/NATAL

The description of the soil series is shown in Figure 4 . Soils surveys have shown problems of a high pH, indicating sodic conditions on some of the clayey soils, causing poor infiltration rates and crusting. High soil water tables were recorded in some areas, which were probably caused by inefficient irrigation. There are also certain areas that require drainage works. Soil analysis data has shown the need for applications of gypsum up to 2 tons per ha. Nitrogen, phosphorus and potassium levels were found to be low. An analysis was made of soil suitability for flood irrigation (Table 6.3).

Table 6.3 Soil suitability for flood irrigation, Bululwane irrigation scheme

Class	ha
1. High suitability	79,0
2. Moderate suitability	66,0
3. Marginal suitability	184,0
4. Limitations	78,0
5. Restricted	282,0
Total	**659,0**

Class I has a high suitability, Class 2 moderate suitability for most crops. Despite limitations, Class 3 is recommended for irrigation provided the irrigation system is efficient and drainage is installed where necessary. Class 4 can be used in special circumstances and is considered suitable for rice production. Generally speaking Class 5 is not recommended for flood irrigation, but could be used for carefully controlled sprinkler irrigation.

6.3.3 Topography

The scheme is approximately 375 metres above sea level. The topography varies from fairly flat (0-3%) in the lower lying areas to slightly sloping (3-6%) in the higher lying areas.

6.3.4 Water Resources

There is no reliable data on river flow from the Bululwane river. It appears that approximately once in every four years there is a risk of no river flow from August to November. In practice, without extra storage, regular shortages of at least one month can be expected, especially in August and possibly in September and April. Analysis of the chemical composition of water from the Bululwane river has shown that the water is "too pure for irrigation" (CAPROS,1980). This paradox is ascribed to the low salt content of the water. As a result of this, severe permeability problems are expected with continuous use, which may require applications of gypsum.

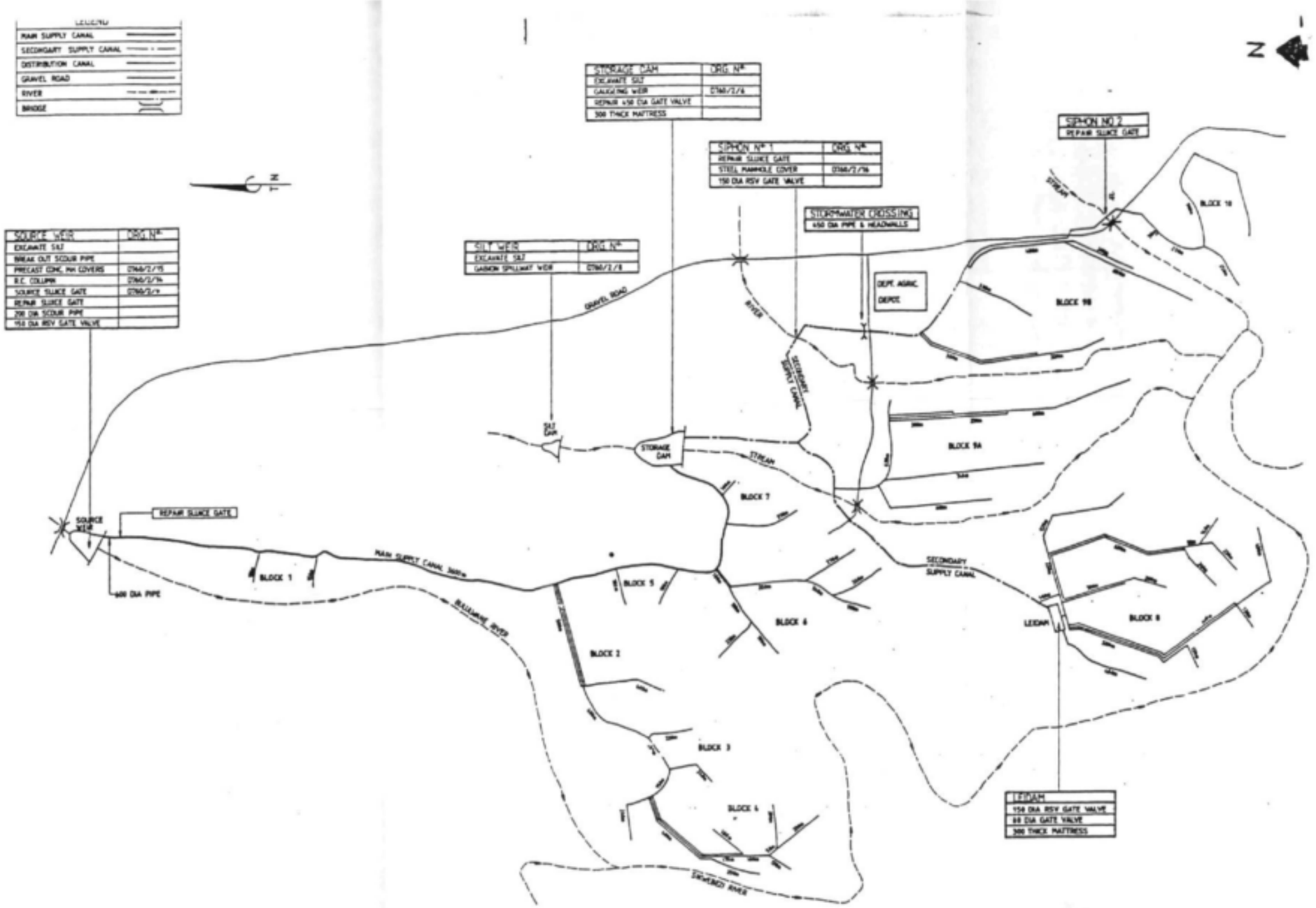


FIGURE 5 BULULWANE IRRIGATION SCHEME

KWAZULU/NATAL

SCALE 1 : 20 000

6.3.5 Domestic Water Supplies

Domestic water supplies were mainly from rivers, springs, wells, dams or communal boreholes. In some cases water was brackish or polluted. Average household consumption was approximately 151 litres per day. Household members had to make 3 to 4 journeys per day to carry water (McEwen, Mthembu and Ngubane, 1998). It has been reported from the local clinic that canal water is a hazard for diseases such as bilharzia and internal parasites.

6.4 INFRASTRUCTURE

6.4.1 General infrastructure

The scheme is well served by a gravel road from the main Ulundi-Nongoma tar road. There are two primary and one secondary schools serving the area. There is one tea room and 10 retail outlets, none of which carry farm inputs. The area is served by one clinic near the scheme.

6.4.2 Irrigation infrastructure

The scheme has a distinct advantage in having a gravity water supply. Water is led to the beds by means of a concrete canal system fed from a weir on the Bululwane river (Figure 5). Due to the age of the scheme, canals and distribution sluice gates have become worn and corroded and are badly in need of repair. In addition to wear and tear on the canals, the main storage dam and the silt dam have become silted up. An amount of approximately R1 million was allocated by the Department of Public Works for the upgrading of the scheme to improve the functioning of the scheme.

It became apparent that funds allocated for repair and upgrading were completely inadequate. The funds allocated were only able to cater for priorities such as rebuilding part of the main canal (170m) and patching up other areas, rebuilding part of the overflow canal from the main storage dam and 1800 metres of secondary canals, new sluice gates and pipe outlets. Labour for these repairs was drawn largely from the local community. An immediate problem is incorrect specification of ball valves.

Repairs and upgrading still required to utilise the present 345ha, include desilting the weir (R100 000), soil conservation works on the gully below the silt dam (R80 000), further desilting and raising of main storage dam (R250 000), desilting the dam on Block 8 (R201 000), further repairs on the main supply canal (R30 000), further upgrading of secondary canals (R110 000), upgrading of distribution canals (R180 000), and upgrading storm water drains and roads (R450 000). Allowing for contingencies, establishment costs of contractors, professional fees and supervision, it is estimated that a further R2million will

be required to get the scheme in good working order (Theron, Burke and Isaac, 1998, personal communication).

6.4.3 Farming structures

The KwaZulu/Natal Department of Agriculture (KNDA) has a poorly equipped office and two houses for extension officers on the scheme. The KNDA operates two tractors and there are two local contractors supplying draught power to participants.

6.4.4 The Irrigation Scheme

Water is diverted by gravity canal and distributed to the various sections along a system of concrete canals where flood irrigation is practised. The canal is designed to cater for 550ha, although only 345ha are presently under irrigation (Figure 5). Irrigation is applied by a system of furrows. This inefficient method often results in over-irrigation, which in turn leads to waterlogging and salinity problems

6.5 LOCAL INSTITUTIONS

Since King Zwelithini's palace is in close proximity to the scheme, the monarch exerts a great influence over the scheme. The Tribal Authority also still exerts a good deal of influence. However, rival political parties of Inkatha and the ANC are often the cause of conflicts. There is an overall scheme committee with representatives from the various blocks, as well as Block committees for each of the 10 blocks.

6.6 CROPS AND LAND-USE

Up to now, the major crops produced on the scheme are maize, cabbage, tomatoes, onions, potatoes and beans. There is no reliable data on crop yields, but from observation average yields are well below optimum due to lack of inputs, poor cultural practices, inefficient irrigation and lack of knowledge. The yield potentials of current irrigated crops are shown in Table 6.4.

Table 6.4 Estimated potential yields of suitable crops for Bululwane irrigation scheme

Crop	Potential yield	Gross margin per ha (R)
Green beans (round)	14-20 tons	N/A*
Tomatoes	40 tons	18246.00
Maize (dry)	7 tons	1711.00
Onions	20-30 tons	N/A*
Cabbage	40-50 tons	13096.00
Potatoes	40 tons	9325.00

*Not available

Other crops which have good potential on the scheme include rice, wheat, dry beans, groundnuts, green peas, sweet potatoes, pumpkins and madumbis. Because it is a frost

free area, there is good potential for various types of vegetables such as cauliflower, spinach, beetroot, chillies,carrots and cucurbit. However, distance from markets is a constraint. There is a limited market for fresh produce in Ulundi and Nongoma. The area also has a potential for sub-tropical fruit such as bananas, pawpaws, avocados, mangos and guavas.

6.7. PARTICIPANTS' AND NON-PARTICIPANTS' PERCEPTIONS

The following is a summary of the perceptions of scheme participants and non-participants based on structured group discussions. Non-participant groups included the dryland farmers' committee as well as Indunas and Councillors.

6.7.1 Scheme objectives

Both participants and non-participants perceived that the main objective of the scheme was to provide food security for the community. The Indunas and Councillors also perceived that food security would enhance the health of the community.

6.7.2 Scheme rehabilitation

Both participants and non-participants were unanimous that the scheme should be rehabilitated.

6.7.3 Scheme services

Participants were dissatisfied with scheme services due to a shortage of draught power resulting in late planting.

6.7.4 Benefits for non-participants

Indunas, councillors and dryland farmers felt that non-participants had not benefited from the scheme, which suggests there was little surplus food for sale to the local community.

6.7.5 Consultation with the community

There was general satisfaction with the degree of consultation when the scheme was launched some 40 years ago.

6.7.6 Scheme impact

The consensus was that the scheme had assisted in alleviating rural poverty and contributed to increased income for participants. There was also agreement that living standards in the area had improved since the scheme was launched.

6.7.7 Scheme participation

The general perception was that all those who wished to participate in the scheme had been given the opportunity to do so.

6.7.8 Needs to rehabilitate the scheme

In order to rehabilitate the scheme successfully respondents felt there was a need to reconstruct canals and level beds, provide financial assistance for inputs, as well as draught power.

6.7.9 Perceptions on land tenure

Participants, as well as non-participants appeared to be satisfied with the present land tenure system, and the size of plots allocated. Participants felt that those not using their plots should be allowed to lease them to others.

6.7.10 Conflicts

Indunas and Councillors were of the opinion that there had been some conflicts in the past concerning land issues.

6.7.11 Political support

While Indunas maintained there was good political support, dryland farmers felt that opposing political structures were having a detrimental effect.

6.7.12 Farmer participation

Non-participants were of the opinion that farmers were participating adequately in the scheme and that the farmers committee were doing a good job. However, the participants themselves felt that there should be greater farmer involvement in decision making, as well as in scheme maintenance. They also felt the farmers committee should receive training to participate more fully in the planning and running of the scheme. Participants also stressed the need for farmer training in crop production and irrigation techniques.

6.7.13 Farming inputs and markets

Participants cited lack of finance for inputs as a major problem. Because of the subsistence nature of the economy, marketing was not perceived as a problem on the scheme at present.

6.7.14 Irrigation technology

Participants were not satisfied with the present furrow irrigation scheme and expressed a preference for sprinkler irrigation. This pereception may have been influenced by the poor state of repair of irrigation canals, as well as the need for land levelling in certain areas.

6.7.15 Water charges and allocations

No water charges are levied at present. No data were available on water distribution costs. Farmers were in favour of water charges being levied provided they were affordable. They were generally satisfied with the timing of water allocations. Water shortages were experienced in times of severe drought.

6.7.16 Livestock on the scheme

Livestock were perceived as a major problem on the scheme, causing damage to crops. At the same time, it was perceived that fencing was not well maintained.

6.7.17 Gender issues

Since women are heavily involved in working on irrigation plots, as well as some owning plots in their own right, women clearly play a very important role on the scheme.

6.7.18 Water borne diseases

Respondents perceived that water borne diseases had become a problem on the scheme, but were unable to elaborate on the nature of such diseases. Enquiries at the local clinic revealed that bilharzia and particularly internal parasites were a problem among the community. Cases of malaria were also reported.

6.7.19 Crop preferences

Major crops produced on the scheme were maize, cabbage, onions, tomatoes and beans. Participants expressed an interest in cotton growing as an alternative. Crops were produced for both security and to augment household income.

6.7.20 Participation of youth

Because of the poverty situation, small size of plots and lack of security of tenure, youths tend to seek employment in urban centres. Participants suggested that parents should encourage their school children to take part in the scheme through having their own small plots to manage.

6.7.21 Future needs

It was felt that competition between participants on the various blocks would be a means of encouraging increased production. It was also felt that the potential for small and large scale agro-industry should be investigated.

6.8 SCHEME PARTICIPANTS

6.8.1 Introduction

The first plots were allocated in 1962. Over the years, a number of plots were given over to widows and sons of the original plotholders. In the sample 40% of plots were managed by females, a number of whom were allocated plots in their own right.

The following are the results of a stratified household sample survey including respondents from all sections on the scheme

6.8.2 Personal characteristics

Fifteen per cent of heads of households were widowed. The average age of participants was 56 years, with age distribution skewed towards the upper age groups (Table 6.5) Older participants do not have the same motivation, or in some cases, physical strength to carry out farming operations.

Table 6.5 Some personal characteristics of heads of households, Bululwane irrigation scheme, 1998 (N=40)

Characteristic	No.	%
Marital status		
Married	34	85,0
Widowed	6	15,0
Age group (years)		
< 40	5	12,5
41 - 50	12	30,0
51 - 60	6	15,0
> 60	17	42,5
Education level (years)		
No education	9	22,5
0 - 4	14	35,0
5 - 6	7	17,5
7 - 8	8	20,0
> 8	2	5,0

Approximately 57% of heads of households can be regarded as being illiterate. The remainder (43%) can be regarded as functionally literate in Zulu, while only 5% can

probably speak and read English (Table 6.5) The average family size of those living at home was 7,93 persons, with a further average of 1,85 persons living away from home. The average family size was larger than data for the Province as a whole of approximately 6 persons.

6.8.3 Socio-economic characteristics

Approximately one in four (23%) of heads of households were in employment. Occupations included security guards, drivers and operators, rangers and welders

Table 6.6 Some socio-economic characteristics of households, Bululwane irrigation scheme, 1998 (N=40).

Characteristic	No.	%
Employed	9	22,5
Pensioners	24	60,0
No. with annual savings	17	42,5
Household expenditure (R per month)	R706.25 (SD 341,6)	
Expenditure on food (R per month)	R468,25 (SD 207,3)	

Sixty three per cent of households had one or more sons in employment, while this was the case with 60 per cent of daughters. These family members made varying contributions to family income. This factor together with pension income were major contributions to household income and household savings.

Due to lack of records it is difficult to calculate household monthly incomes. At a rough estimate, taking account of crop and livestock production, at least 50 % of households were living in varying degrees of poverty with incomes of less than R1100 per month (Whiteford, Posel and Kelatwang, 1995). This finding is supported by the results of a recent social survey on the scheme (McEwen, Mthembu and Ngubane, 1998)

Sixty per cent of households claimed that the household did not have sufficient food to eat, which supports the estimate of numbers of poverty stricken households. The proportion of monthly expenditure on food (66%) is a further indicator of poverty. In addition to food, major monthly household expenditure was on hire purchase for household equipment, school fees and clothing (McEwen, Mthembu and Ngubane, 1998).

6.8.4 Agricultural production

6.8.4.1 Crops

The average value of crops produced was R832.35 (SD 1547). According to McEwen, Mthembu and Ngubane (1998) an average of R236.89 was spent on inputs. On this basis, crops contributed approximately R50 per month to household income (5%).

Table 6.7 Distribution of households according to value of crops produced, 1998 (N=40)

Value category	No.	%
Nil	7	17,5
200	5	12,5
201 - 400	8	20,0
401 - 600	6	15,0
601 - 800	2	5,0
801 - 1000	3	7,5
1001 - 1200	3	7,5
>1200	6	15,0
Total	**40**	**100,0**

The average size of irrigated plots varied considerably. Forty five per cent had 0,40ha, 45% 0,80ha, while 10% had 1,20ha plots. The average holding was 0,66ha. On the basis of maize production alone, yields were less than half the potential. If other high value crops are considered, present production is only a fraction of the potential.

The most important crops grown in order of importance were cabbages, tomatoes, onions, maize, spinach, beans, beetroot, potatoes and carrots. Probably because of the greater emphasis on higher value vegetable crops and "green mealies", on average, households produced only 37% of their maize grain requirements.

Respondents perceived that tomatoes and onions were the most profitable crops to grow. A number of other crops were also mentioned, including, cabbages, peas, potatoes, and green mealies. Crops favoured for the future were potatoes, beetroot, carrots, green peppers and chillies.

6.8.4.2 Livestock

Cattle

The average herd size was 4,82 head. Only 8,3% of households had an adequate number of animals to provide some draught power, as well as income (>10 head). Eighteen per cent of households sold one or more animals during the past year. A number of households kept small dairy herds.

Table 6.8 Household ownership of cattle, Bululwane irrigation scheme, 1998 (N=40)

No. of Cattle	No.	%
Nil	15	37,5
1 - 2	5	12,5
3 - 4	3	7,5
5 - 6	4	10,0
7 - 8	1	2,8
9 - 10	5	12,5
>10	7	17,5
Total	**40**	**100,0**

Except for a small dairy herd, dependent on purchased feed, there was little integration of livestock and crops on the scheme. In the winter months cattle and goats grazed on crop residues. In fact there was general dissatisfaction concerning cattle causing damage to crops on the scheme.

Goats

Goats are kept mainly for household consumption, including tribal customs, such as funerals and weddings. Only 15% had herds of more than 15 animals (Table 6.9). A small percentage sold one or more goats per annum.

Table 6.9 Household ownership of goats, Bululwane irrigation scheme, 1998 (N=40)

No. of Goats	No.	%
Nil	15	37,5
1 - 5	11	27,5
6 - 10	7	17,5
11 - 15	1	2,5
16 - 20	2	5,0
>20	4	10,0
Total	**40**	**100,0**

Other livestock

None of the households owned any sheep while only 7,5% owned pigs, one of whom was a commercial producer with 20 pigs. Surprisingly, only a minority kept poultry, mainly for home consumption.

6.8.4.3 Implements, vehicles and tools

Ownership of tractors and motor vehicles is a reflection of the general socio-economic situation on the scheme. The shortage of ox drawn implements relates to cattle herd size (Table 6.9).

Table 6.10 Household ownership of vehicles, implements and tools, 1998 (N=40)

Implements/ vehicle/tools	No.	%
Tractor	1	2,5
Bicycle	8	20,0
LDV	3	7,5
Motor car	3	7,5
Ox plough	13	32,5
Ox cultivator	5	12,5
Hoes	38	95,0
Spades	33	82,5
Forks	20	50,0

6.8.4.4 Labour

From Table 6.11 it is clear that most of the labour burden for irrigation falls on women. In addition to farming, women have many other responsibilities such as child care,carting wood and fuel, cooking and looking after small stock.

Table 6.11 Household labour inputs on various tasks, Bululwane irrigation scheme, 1998 (N=40).

Task	Husband	%	Husband + wife	%	Wife	%	Other	%
Planting	8	20,0	10	25,0	21	52,5	1	2,5
Irrigation	7	17,5	8	20,0	25	62,5	-	-
Weed control	5	12,5	8	20,0	25	62,5	2	5,0
Harvesting	4	10,0	10	25,0	24	60,0	2	5,0
Sale of crops	5	12,5	5	12,5	28	70,0	2	5,0

Approximately two in five (38%) of households hired labour for weeding and harvesting. Mean hired labour days per annum was 5,92 days. The majority of respondents perceived weeding as requiring the greatest labour input, followed by planting and irrigation.

6.8.4.5 Land preparation

The majority of households (58%) hired tractors for land preparation. In line with ownership of cattle 38% carried out ploughing themselves with oxen or by hand. Half of

the respondents were dissatisfied with availability of land preparation due to frequent breakdowns of government tractors.

6.8.4.6 Irrigation systems

All irrigation water is supplied by gravity canal. Water is applied to beds 150m x 7m wide. Many beds are uneven and require land planing. According to respondents intervals between irrigations varied widely.

6.8.4.7 Water quality and charges

In general the majority of respondents (83%) were satisfied with the availability and quality of the water as well as with the quality of soils. The majority (78%) were prepared to pay affordable water charges.

6.8.5 Institutional, financial and organisational factors

6.8.5.1 Farming credit

Because of lack of credit facilities for small-scale farmers only 28% had borrowed money for inputs from various sources and had been able to repay the loans.

6.8.5.2 Agricultural marketing

Farmers perceived marketing as a problem due to distances to the nearest local markets at Ulundi and Nongoma. In some cases, it was perceived that the choice of crop was not in line with marketing opportunities.

6.8.5.3 Land tenure

The majority of respondents (83%) were satisfied with present land tenure arrangements of "the right to occupy". Livestock causing damage to crops was perceived as a threat to security by a minority (18%) of respondents.

The majority (90%) of farmers were satisfied with the size of irrigation plots. They were also generally not in favour of selling or leasing plots to others (85%) because it was perceived as tribal land to be used by the community. Suprisingly only 20% aspired to acquiring more land. A general conclusion was that on this scheme land tenure is not considered a constraint to agricultural development.

6.8.5.4 Farmers' committee

There seemed to be general satisfaction with the scheme farmers' committee. Farmers were generally satisfied with communication between the farmers committee and project management, as well as with individual farmers. However, the majority of respondents

(75%) felt the farmers committee should have a greater say in decision making, managing water distribution and allocation, as well as scheme financing.

6.8.5.5 Scheme management

Farmers were divided in their perceptions of the efficiency of project management. Forty per cent rated management as poor or average, while 55% rated it as good. The reasons given for poor ratings included "lack of supervision", "looking after themselves", "disinterested" and "poor communication". Other criticisms of scheme management included delays in providing services, lack of draught power and inputs, as well as animals causing damage to lands.

6.8.5.6 Extension services

The majority of farmers (70%) sought advice from local extension workers, while others sought advice from committee members, fellow farmers and the tribal authority. The majority (70%) preferred male to female extension officers. The need for training extension workers in irrigation farming was emphasised in 4.8.

6.8.5.7 Farmer training

Respondents were divided as to whether farmers were adequately trained to assume greater responsibility in the management of the scheme. Perceived training needs were for management skills, irrigation techniques, crop production and mechanical skills.

On an individual basis farmers perceived the need for training in management, crop production and marketing.

6.8.6 Socio-psychological Factors

6.8.6.1 Scheme objectives

Major objectives of the scheme were perceived as improved livelihoods, producing crops all year round and to provide food security. Farmers felt they had benefited from the project in terms of producing more food as well as selling produce to improve family income.

6.8.6.2 Scheme rehabilitation

Participants were unanimous that the scheme should be rehabilitated and upgraded. The major perceived needs to rehabilitate the scheme included improved draught power, fencing off arable lands, improved water distribution, provision of inputs and improved irrigation technology.

6.8.6.3 Farmer participation

A majority of respondents (55%) felt management of the scheme should be taken over by the farmers themselves. Others felt government should continue with management. Those who felt farmers should take over management conceded that initially they would require the assistance of extension officers and other advisers.

6.8.6.4 Perceived problems

The most important scheme problems perceived as requiring attention included, in order of importance : provision of draught power, improved water distribution, fencing off arable lands and theft prevention.

6.8.6.5 Conflicts

The most important conflict situation on the scheme centred on water distribution and animals causing damage to crops. Perceived solutions were negotiations on upgrading the water distribution system, and hired security to prevent theft and animals gaining access to irrigation lands.

6.8.6.6 Farm decision making

The importance of women in farm related decision making is reflected in Table 6.12. The majority of decisions are made either by women alone or jointly with their spouses.

Table 6.12 Farmer decision making, Bululwane irrigation scheme, 1998 (N=40)

Decision category	Husband	%	Husband + wife	%	Wife	%	Other	%
Crops to grow	6	15,0	12	30,0	20	50,0	2	5,0
Purchase of inputs	10	25,0	8	20,0	22	55,0	-	-
Household labour	8	20,0	5	12,5	25	62,5	2	5,0
Crop marketing	3	7,5	6	15,0	31	77,5	-	-
Household expenditure	7	17,5	10	25,0	22	55,0	1	2,5

Decision making patterns are a reflection of the large percentage of women managing plots on their own (Refer 6.13.1), as well as labour inputs of women (Table 6.11)

6.8.6.7 Gender issues

Results of this study show the key role of women in both decision making and labour inputs on irrigation holdings. General perceptions were that the scheme had resulted in women having heavier work, and working longer hours. It was perceived also that since the irrigation scheme was launched the majority of women are more dependent on their husbands (88%), previously had greater access to land (73%) and had less income of their own (60%). It was also perceived that they had less food for their chickens (98%), which accounts for the general lack of interest in poultry (Refer 6.13.4.2).

6.9 VIABILITY ASSESSMENT

The scheme has the distinct advantage of being a gravity flood irrigation system with relatively low running costs. However, approximately R2 million needs to be spent on upgrading the infrastructure, including desilting storage works, upgrading canals and soil conservation works to make the scheme fully functional and more efficient (Table 6.13)

Present levels of production are extremely low, giving a gross margin per ha of approximately R800 against a potential of R4000 to R6000 (Table 6.13). If high return cash crops such as tomatoes, potatoes, and cabbage are produced, the potential gross margins are infinitely higher (Refer Table 6.4), provided of course suitable marketing outlets are in place.

An important issue is that approximately one-third of plot-holders are not utilising their plots, as well as the fact that a preponderance of plot-holders (43%) are in the upper age groups (>60years), with a high level of illiteracy, which adds up to a fairly low level of trainability among about 40% of plot holders.

Of particular concern on this scheme is the fact that only 145ha comprises soils of high to moderate suitability. The calculations in Table 6.13 are based on utilising only suitable soils. If ways and means can be found of effectively and economically utilising the 184ha of soils with marginal suitability, then the potential returns on rehabilitation costs become more than twice as favourable. This is provided that the participants effectively assume responsibility for any drainage or conservation works required.

Table 6.13 Estimated viability of rehabilitating the Bululwane Irrigation Scheme, 1999.

	Total	**per ha.**
Capital cost	2,000 000,00	13,793.10
Interest on capital @ 17%*	342 000.00	2 358.62
Gross margin on crops**		
Maize for sale (external)	599 574.00	4 135.00
Maize for consumption (internal)	839 559.00	5 790.00

*Redemption over 30 years
**Based on 60% maize (7 tons/ha.) 20% legumes , 20% vegetables.

The difference in projected income based on maize for sale as opposed to consumption, is that the latter is worth at least double the producer price if utilised for food. An important issue to be solved before proceeding with further rehabilitation is to reach agreement with local structures in re-allocating plots on the suitable soils to participants who are likely to make full use of them. At the same time, the possible use of marginal soils needs to be fully investigated.

A concerted extension programme and support services will be required to achieve the projected gross margins shown in Table 6.13. Because of human constraints of age, education and other factors the projected levels are unlikely to be achieved in the short term. At present rehabilitation can only be sustained on socio-political grounds.

A general conclusion based on the current socio-economic situation, is that the scheme could play a significant role in alleviating poverty in the area if the Government fully subsidises the cost of rehabilitation. With the favourable climatic conditions there is a potential for on-scheme processing of selected crops, which needs to be investigated further. In addition, the guidelines for rehabilitation outlined in 8.4 of this report need to be followed.

6.10 CONCLUSIONS

- A major advantage of the long established Bululwane scheme is that it has a gravity flow supply system with low water distribution costs. There is merit in upgrading the scheme provided the capital cost is written off.

- The study has shown a general poverty situation among scheme participants, including lack of food security and low incomes.

- Although current production levels are considerably below potential, the scheme has had a positive impact in terms of food production and poverty alleviation. At the same time, income from irrigation can be increased significantly.

- Because it is frost free, the scheme has the potential to produce a wide variety of field crops, vegetables and fruit.

- A major problem facing the scheme is the lack of funds to complete essential maintenance, upgrading and repair works to make the scheme fully functional.

- Bed irrigation is in many cases inefficient due to unevenness and poor ploughing techniques.

- Unlike many other irrigation schemes security of tenure was not perceived as being a problem. Of concern, however, was the finding that more than one-third of participants were not using their irrigation plots. Although the KwaZulu Natal Department of Agriculture had received requests for plots, there was no direct pressure from the local community on this issue.

- Crop yields are considerably below optimum due to the low level of inputs and inefficient irrigation.

- Because of the breakdown of government tractors, inadequate draught power is a major constraint to production.

- Women play a major role in providing labour, as well as in farm decision making on the scheme. They need to play a greater role in management of the scheme.

- An overall scheme committee and Block irrigation committees are in place, but require development and training if they are to fulfil a wide role in management and maintenance of the scheme. Capacity building and community participation are equally important to increased productivity in alleviating rural poverty.

- Although there are certain political differences within the community, the Zulu King Goodwill Zwelithini, who has one of his palaces nearby, plays a significant unifying role in the community.

- Due to its relative isolation from the main centres in the province, marketing of produce is a problem.

- There is a need for greater access to credit for farm inputs on the scheme.

6.11 RECOMMENDATIONS

⇒ A general recommendation is that the scheme has great potential for increased production and should be upgraded on the 145ha of suitable soils, provided Government is prepared to write-off the capital cost.

⇒ It is recommended that a skilled facilitator be appointed to assist in restructuring the scheme committee and Block Committees to play a greater role in scheme management and maintenance.

⇒ It is recommended that the present scheme committee be incorporated into a legal Water Users Association (WUA), which can take over scheme assets, take out collective loans, operate accounts and institute by-laws enforceable by its members. The WUA to be responsible for management and maintenance of canals and structures to field edge of the 10 Blocks. The Association would also be responsible for negotiating farm inputs, draught power and marketing.

⇒ It is recommended that initially the scheme be jointly managed by the WUA along with the Department of Agriculture and the Department of Water Affairs, or their appointed agents, until such time as the WUA is competent to take over full management responsibility.

⇒ It is recommended that the present Block Committees be formed into legally constituted structures. The Block Committees will be responsible for water management and maintenance from field edge of the Block, as well as extension services, ploughing services and input supplies in co-operation with the WUA. It is important that the WUA and Block Committees participate in the upgrading process from the planning stage through to evaluation.

⇒ Although land tenure *per se* is not considered a problem, it is recommended that the WUA in consultation with the Block Committees investigate the possibility of other plot holders taking over or leasing plots not being used at present, as well as re-settlement of a reduced area.

⇒ Obtaining funding to upgrade the infrastructure as detailed in 6.8.2 is of prime importance. This includes desilting the weir and storage dams, further repairs to the main supply canal, secondary and distribution canals, at an estimated cost of R2 million.

⇒ There is also a need to improve irrigation efficiency on irrigation beds by land planing as well as investigating adapting to short-furrow irrigation techniques.

⇒ It is also important that tractor drivers be trained in correct ploughing techniques for flood irrigation layouts

⇒ It is recommended that, where possible, members of the local community become involved in the process of upgrading the scheme infrastructure.

⇒ It is recommended that the KwaZulu/Natal Department of Agriculture (KNDA) appoint trainers to upgrade leadership and management skills of the WUA, Block Committees and extension workers to maximise the benefits of the upgrading process. Extension workers also need training in irrigation techniques and crops.

⇒ There is a special need to train farmers, especially women, in irrigation farming techniques.

⇒ The scheme has the potential to produce a wide range of commodities. Recommended that the KNDA, in co-operation with appropriate research organisations, initiate on-farm research aimed at producing viable farming systems, bearing in mind the marketing situation. Minimum tillage techniques are also worthy of investigation.

⇒ Recommended that the KNDA together with appropriate research organisations, investigate the potential for effectively utilising marginal soils and soils with limited and restricted suitability for irrigation, including sub-surface drainage.

⇒ It is recommended that KNDA agricultural economists liaise with the research team to undertake market research on suitable farming systems, including identifying suitable marketing partners

⇒ Recommended that the KNDA, in co-operation with the WUA investigate solutions to the problem of draught power, including animal draught power.

⇒ Recommended that the WUA liaise with the Land Bank to obtain farming input credit for those requiring it.

⇒ It is important to stress that the upgrading of the scheme can only succeed by initially establishing a strong partnership between the WUA, the KNDA and the private sector aimed at maximum farmer participation, as well as empowering local structures to eventually take over the maintenance and operation of the scheme themselves.

⇒ Further upgrading of the scheme should not take place until a facilitator is appointed and the Water Users Association and Block Committees are legally constituted and committed to participating in the management of the scheme.

CHAPTER 7

THUKELA ESTATES IRRIGATION SCHEME

7.1 GENERAL DESCRIPTION AND HISTORICAL BACKGROUND

The Thukela Estates irrigation scheme has a long history going back to 1912 when Ndoda the forefather of the present chief (Nkosi) Mtemba started the scheme with the aid of a commercial farmer who constructed the original irrigation canal to irrigate plots along the banks of the Tugela river. With the implementation of the 1921 Land Act the original community was removed from the land. Commercial farmers successfully farmed and owned the scheme until 1963 after which it was leased to various commercial farmers until 1969 when the land reverted to Kwa Zulu. Up to this time the scheme was apparently very productive, with large amounts of produce, mainly vegetables, being marketed on the Natal South Coast.

Until 1984 the scheme was leased to the KwaZulu Agricultural Company (KAC) who assisted small-holders to re-establish the scheme. In 1985 the responsibility for the scheme was taken over by the KwaZulu Department of Agriculture who assisted the local community under the Tribal Authority to manage the scheme. Since 1994 the scheme has been the responsibility of the KwaZulu/Natal Department of Agriculture.

Because of the lack of maintenance and deterioration, the original canal is no longer functional and only about 30% of the productive area of the scheme is being utilised by pumping from theTugela river (Figure 6). Virtually all of the 1275 households living near the scheme have been allocated plots of varying sizes. Seventy per cent of potential participants are unable to irrigate due to constraints of the canal system, as well as breakdowns of the pumping system. This has resulted in a situation of extreme poverty. The situation is exacerbated by endemic faction fights within the community, often resulting in deaths.

7.2 PROBLEM DEFINITION

The major problems identified on the scheme were as follows:-

- The collapse of the main supply canal and ancillary works and the poor state of repair of the pressurised system.
- Lack of unity and stability within the community due to internal faction conflicts
- Lack of active farmer participation in the running and maintenance of the scheme.
- Due to the pertaining poverty situation a large proportion of potential participants do not have the necessary resources for inputs.

TUKHELA ESTATES IRRIGATION SCHEME

KWAZULU/NATAL

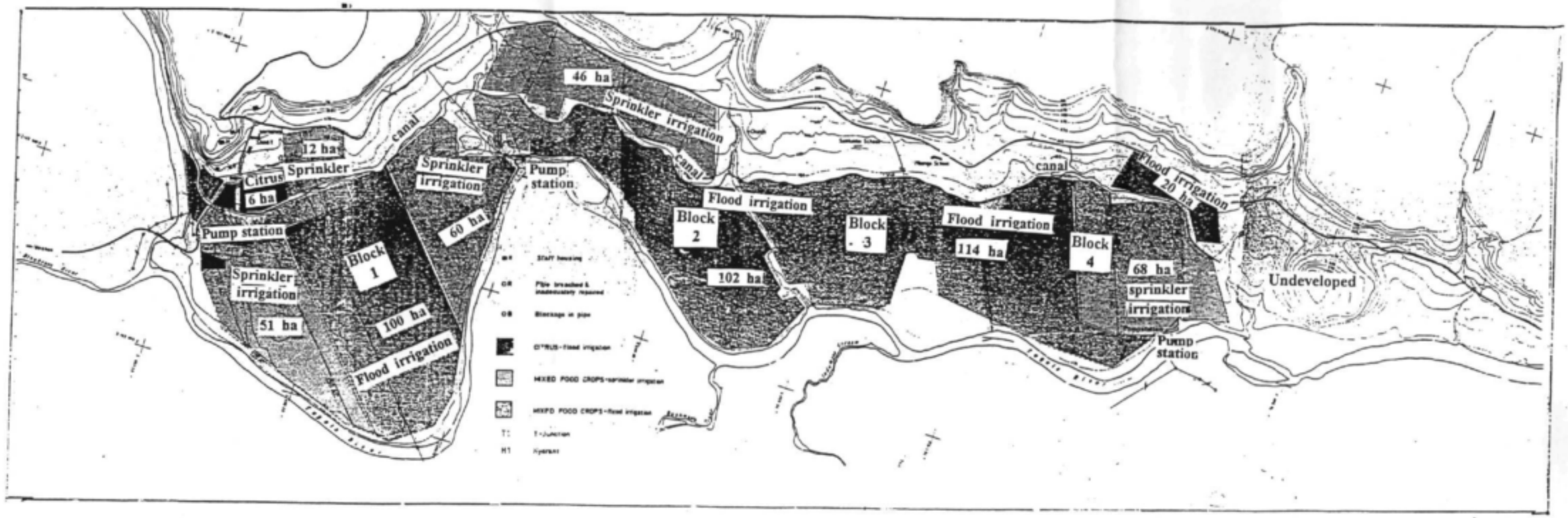


FIGURE 6 IRRIGATION LAYOUT

- As mentioned above is there a general lack of management and entrepreneurial skills among the community.

7.3. PHYSICAL FACTORS

The climate, soils and water quality have been thoroughly researched and documented in the past (O'Connel, Manthé and Partners Inc., 1983; Eksteen, van der Walt and Nissen, 1985; 1989).

7.3.1 Geographical Situation

Thukela Estates is situated on the northern bank of the Tugela river downstream from the Spioenkop Dam which augments the normal flow of the river. The scheme is situated approximately 18kms north-east of Weenen.

7.3.2 Climate

The mean annual rainfall is 622mm (Table 7.1) and the mean annual A-pan evaporation is 1983mm (Table 7.2).

Table 7.1 Mean annual rainfall mm., Thukela Estates

Jan	Feb	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
111	77	69	38	17	9	10	16	32	58	85	100	622

Table 7.2 Mean Annual A-Pan evaporation mm., Thukela Estates

Jan	Feb	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
213	194	192	141	112	84	102	136	166	174	232	237	1983

Light frosts occur from May to the end of September and severe frosts may occur during June and July. Some heavy frosts are likely to occur every second or third year.

7.3.3 Soils

In general the area is characterised by alluvial deposits on the areas adjoining the Tugela river and colluvial deposits between this area and the steeper valley slopes.

The texture of the alluvial sediments vary from sandy near the river to clayey towards the colluvial areas. Colluvial deposits are general clayey, the clay proportion progressively increasing downslope.

TUKHELA ESTATES IRRIGATION SCHEME

KWAZULU/NATAL

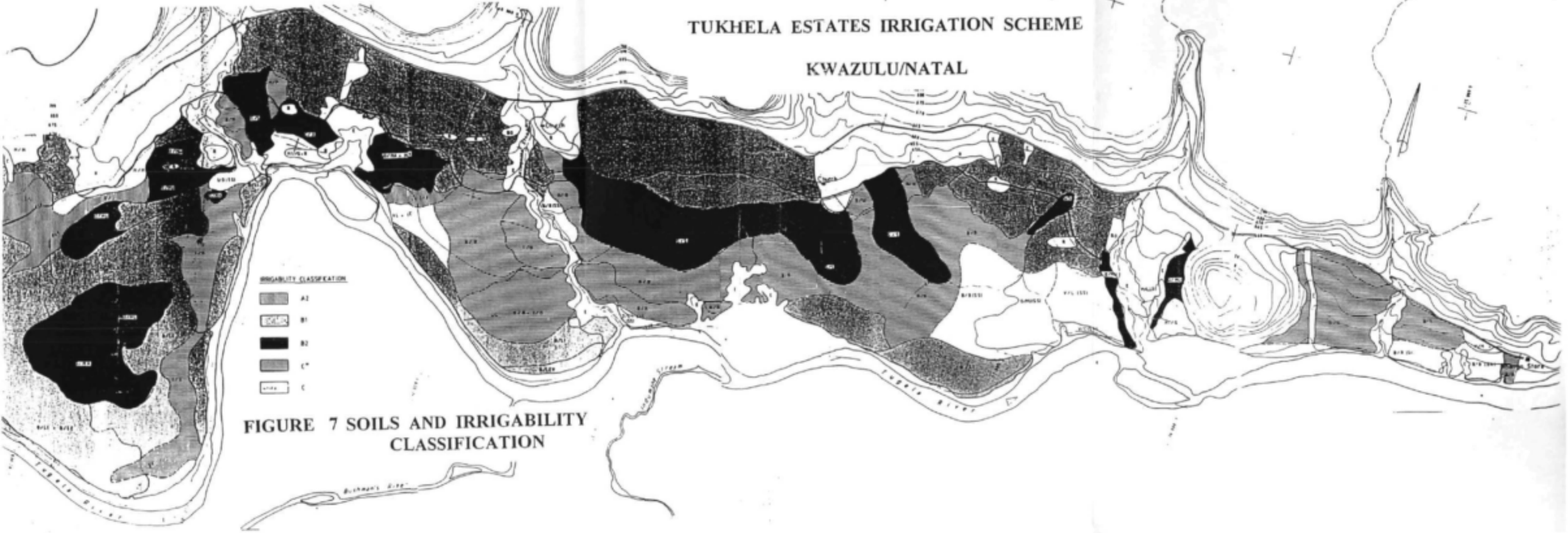


FIGURE 7 SOILS AND IRRIGABILITY CLASSIFICATION

From an irrigation potential point of view the alluvial areas contain some good light and medium textured soils of the Oakleaf Form, as well as heavy textured soils of both Oakleaf and Bonheim Forms (Figure 7).

The colluvial deposits on the upper slopes towards the canal comprise irrigable soils of moderately good potential, chiefly of the Shortlands Forms, grading into heavier less favourable soils, chiefly of the Bonheim form. Previous irrigation practices led to a localised build up of salinity and alkalinity in some areas.

The pedological survey identified 27 soil series belonging to 12 forms (Partridge, de Villiers and Associates, 1983). Approximately 533ha (A & B class) can be regarded as of reasonably good irrigation potential, while 280 ha of 'C' class soils are more suited to sprinkler irrigation which may in certain circumstances require subsurface drainage if over irrigated. (Figure 7).

A general conclusion is that with sound irrigation management suitable soils are not a constraint on this scheme. However, it is doubtful whether at this stage it is feasible or affordable to irrigate the Class C soils. Further investigation and research is required.

7.3.4 Topography

The scheme comprises a relatively wide gently sloping valley extending up to 2,5kms from the Tugela river. Gradients range from 0,4% to 7%, with an average of 1,5%. Elevation of the scheme is approximately 650m above sea level.

7.3.5 Water Resources

The quality and potential quantity of water from the Tugela river do not impose a constraint on the development of the irrigation scheme. The fact that a large proportion of the scheme can be commanded by flood irrigation from the main canal is a distinct economic and management advantage.

7.3.6 Domestic Water Supplies

Of 7 boreholes, only three were functional and equipped with hand pumps. A reticulation system distributes water to the staff houses and offices. There is a dire need to provide additional communal water supplies to the villages through a reticulation scheme by pumping from the Tugela river, for which plans have already been drawn up (Eksteen, van der Walt and Nissen, 1993).

7.4. INFRASTRUCTURE

7.4.1 General Infrastructure

Access to the scheme is via a good gravel road from Weenen. A concrete bridge links this road to the scheme. On the scheme itself is a gravel road, not in very good condition.

7.4.2 Irrigation Infrastructure

The irrigation scheme consists of pump stations at Block 1, Blocks 2 & 3 and Block 4 (Figure 6) all equipped with electric pumps.

The original main canal and much of the piping is in a poor state of repair and has been in disuse for some years. It is estimated that it will cost a further R5 279 951, in addition to the R2 548 681 already spent, to bring water to field edge (KwaZulu Natal Department of Agriculture, 1998).

The overall cost of bringing the scheme into full production is estimated by the KwaZulu/Natal Department of Agriculture (1999) as follows:-

	R
Main canal to field edge	5 279 951.00
Repair pressure pipe	100 000.00
Replace above ground sprinkler system	1 233 000.00
Repair field equipment	103 133.85
Refurbish main canal	825 000.00
Land planing	200 000.00
	7 741 084.85

Assuming all plot holders would benefit from the scheme rehabilitation, the average cost per farmer would be approximately R6071.00.

7.4.3 Farm Structures

There is an office block adjacent to the scheme which is in a poor state of repair and without adequate equipment. A shed adjoining the offices is in reasonable condition, while another shed is in a poor state of repair. There is also a workshop with electric power.

There are 4 staff houses on high ground near Block 1 (Figure 6). A tribal courtroom with two offices is situated near the shed. Three trading stores have limited stocks of household goods, and there are two churches. The Mbongo Primary School (700 pupils) and Sablombe High School provide formal education.

7.4.4 The Irrigation Scheme

The existing irrigation system consists of a quick coupling sprinkler system (234ha) and a flood irrigation system from the main canal which is not in use, but is currently estimated to be able to irrigate 550 ha.

Each of the three pump stations are equipped with two electrically driven centrifugal pumps. The potential for sprinkler irrigation from the three pump stations is 234ha. The design has been based on pumping 6 days per week and 20 hours per day. During the peak demand period from August to February sprinklers are meant to be moved at 07h00 and again at 17h00 in the afternoon, resulting in two shifts per day. The sprinkler spacing varies between 12m x 12m and 12m x 18m to accommodate varying plot sizes.

The pump stations are prone to flooding with resultant high maintenance costs. Pipelines often burst due to the class of piping and poor installation. The conventional moveable pipe system has the advantage of accommodating a wide range of plot size and farmer abilities. It also has the advantage of greater farmer involvement, low maintenance and relatively low capital cost.

A land register indicating plot numbers, sizes, name and gender was available. 1275 plots have been allocated, of which only 382 (30%) are presently irrigated due to non functioning of the canal, as well breakdowns of sprinkler systems. Approximately 24% of plots were allocated to women, mainly widows. Original settlers have larger holdings than newer settlers who came from outside the area. The average plot size is approximately 0,51ha.

7.5. LOCAL INSTITUTIONS

A number of attempts have been made in the past to revitalise and rehabilitate the Thukela Estates Irrigation Project. Apparently institutional problems relating to land allocation, inappropriate management and lack of participation have led to failure (Lyster, 1987).

Institutional problems and the lack of farmer participation in the organisation and management of the scheme have undoubtedly been a major reason for the failure of the scheme.

Thukela Estates is divided into 3 sub-wards each with an Induna. Five Farmers' associations have been established on the scheme on a Block representative basis. The Tugela Estates Development Committee (TEDC) was established in 1988. Their stated function was to initiate and propose all development work in the area. The main objective at present is to upgrade the irrigation scheme through upgrading the canal for flood irrigation and repairing pipes for sprinkler irrigation. The KwaZulu Department of Agriculture provides extension and other services.

The expectation was that this would result in food security for the community as a whole, as well as additional income to alleviate poverty.

7.7.3 Scheme Services

There was general dissatisfaction concerning the services provided by the Department of Agriculture. This was largely due to the canal not working, unreliable pumps and shortage of draught power. There was dissatisfaction that pump operators did not work over weekends and water was only available for 8 hours a day during weekdays. Not unnaturally respondents perceived the solution as remedying these deficiencies.

It was felt that not only was there a need to strengthen extension services, but also to provide better transport. Farmers' perceptions of the need for future support systems, included provision of credit for inputs, draught power, upgrading and repairing the irrigation system, as well as extension advice on appropriate crops, irrigation techniques and management. Other perceived needs were for land levelling, fencing and training of farmers to operate and maintain the scheme themselves.

7.7.4 Credit, Inputs and Marketing

Respondents were unanimous that the majority of participants did not have adequate resources to pay for essential inputs. They expressed a need for seasonal crop loans, as well as the establishment of savings clubs. Those participants who had received loans in the past found it difficult to repay because of high interest rates, low yields and inadequate income.

Because of the distance from larger centres, produce marketing was perceived as a problem and it was felt there was a need to establish local markets.

7.7.5 Irrigation Technology

Farmers expressed general dissatisfaction with present irrigation systems, suggesting flood irrigation and additional pipes and sprinklers to ensure an equitable distribution of irrigation water.

7.7.6 Water Charges and Allocations

Discussion participants were unanimous in the viewpoint that farmers would be willing to pay for water, provided rates were at a reasonable level.

Respondents were divided about their satisfaction of water allocations. Those who were dissatisfied said there was a need for better control and expressed a need for farmers to be trained to manage pumps under farmer control.

7.7.7 Livestock on the Scheme

Participants were unanimous that livestock posed a problem on the scheme by being allowed into the irrigation lands, particularly during the dry season, resulting in damage to crops. The poor state of fencing was cited as a major cause of this situation.

The majority of discussion participants perceived that fences were not adequately maintained. It was suggested that farmers themselves should repair and maintain fences, or alternatively, a fencing repair team should be employed.

7.7.8 Farmer Participation

Perceptions on current farmer participation in the running and maintenance of the scheme was limited to dialogue and co-operation with the Tribal Authority and the Department of Agriculture through local Farmers' Association structures. There was limited participation in carrying out minor repairs, fencing and water reticulation.

Discussion participants were unanimous that there should be greater farmer participation in the scheme through control of pump operators and water bailiffs, scheme maintenance and repairs, as well as general decision making.

7.7.9 Scheme Maintenance

All respondents perceived that maintenance on the scheme was presently inadequate. It was a unanimous opinion that there should be greated farmer involvement in the maintenance of the project. It was felt that funds should be made available for training farmers to maintain canals, furrows, pipelines and other infrastructure. It was suggested that farmer involvement should not only be in providing labour, but also in supervising pump attendants to provide water over weekends and for longer hours during the day.

7.7.10 Role of the Farmers' Committees

Discussion participants were unanimous that the efficiency of the Umbrella committee, as well as Block committees could be improved by better communication, co-ordination and co-operation among the various role players to ensure the irrigation potential was fully utilised for the benefit of the community. It was felt that funds should be made available for management training of all committee members aimed at greater participation and efficient and effective running of the scheme.

7.7.11 Gender Issues

While women play an important role in the scheme by virtue of their participation in working their household plots, as well as in decision making, it was nevertheless felt that there should be greater involvement of women in the decision making process.

7.7.12 The Role of Youth

Respondents were unanimous that the best way of involving young people on the scheme was to allocate them small food plots which they could be trained to work themselves.

7.7.13 Farmer Training

Discussion participants were unanimous on the need for farmer training, particularly in the fields of crop production, irrigation techniques, record keeping, management and tractor maintenance.

7.7.14 Land Tenure Arrangements

Respondents were divided on the land tenure issue. The umbrella committee tended to opt for individual title, with land being allocated only to active farmers, while the remainder felt the *status quo* of land being controlled by the Tribal Authority should be maintained.

The majority of respondents were of the opinion that plot holders not using their plots should at least be able to lease their plots to others. Those who disagreed said "the land belonged to the tribe".

Respondents were equally divided on their satisfaction or dissatisfaction with the present size of plots. Those who felt that plots should be larger suggested increased plot sizes of anything from 0,5ha to 5,0ha. There was also divided opinion on the question of whether all participants should be allocated the same size of plot . Those in favour felt it would be a more equitable distribution of income if everyone was allocated the same plot size. Those who disagreed felt there was a need for greater competitiveness, as well as the need to allocate land to those with proven farming ability.

7.7.15 Crop Preferences

Crop production was mainly for household food security purposes with any surplus being sold. A wide range of crops have been grown on the scheme, including maize, groundnuts, tomatoes, beans, cabbage, soyabeans, sweet potatoes, swiss chard, peas, potatoes and various other vegetables. Previously 10ha of citrus was grown, but the orchards have been completely neglected.

7.8 SCHEME PARTICIPANTS

7.8.1 Introduction

As mentioned in 7.1 only about 30% of the productive area of the scheme is being utilised at present. The remaining 70% are unable to utilise their irrigation plots due to various engineering constraints. The following are the results of a sample survey of 36 households currently utilising irrigation plots and 31 households (non irrigators) who have been allocated plots but are not able to utilise them at present.

In the case of IRRIGATORS (I) and NON IRRIGATORS (NI), the majority had been using irrigation plots for an average of 11 and 15 years respectively. Seventy one per cent of irrigators were original settlers against 23% of non irrigators.

7.8.2 Personal characteristics

Nineteen percent and 23% of the I and NI groups of heads of households were widowed (Table 7.3). In 31% of the I sample, plots were allocated to females compared to 21% in the N I group. The average age of participants was 56 years ($S^2$13,2). There was a higher percentage over 60 years of age in the NI group (Table 7.3) Older participants tend not to have the same motivation as those in younger age groups who have families to support. They also tend to have less physical strength to undertake farming operations.

Table 7.3 Some personal charactistics of heads of households, Thukela Estates, 1998. (N = 67)

Characteristic	I (n = 36)		NI (n = 31)		TOTAL (n = 67)	
Marital status	**No.**	**%**	**No.**	**%**	**No.**	**%**
Married	29	80,6	24	77,4	53	79,1
Widowed	7	19,4	7	22,6	14	20,9
Age group (years)						
< 40	5	13,9	1	3,2	6	9,0
41 - 50	10	27,8	7	22,6	17	25,4
51 - 60	11	30,6	10	32,3	21	31,3
61 - 70	8	22,2	9	29,0	17	25,4
> 70	2	5,6	4	12,9	6	9,0
Education level (yrs)						
Nil	25	69,4	21	67,7	46	68,7
0 - 4	7	19,4	8	25,8	15	22,3
5 - 6	4	11,1	2	6,5	6	9,0
7 - 8	0	0,0	0	0,0	0	0,0

Education is regarded as a basic human need, which in turn is seen as a means of meeting other basic socio-economic needs and accelerating overall development through skills training. According to educationists, people with less than 4 years of formal schooling are unlikely to attain any degree of literacy (Koshy, 1977). At Thukela Estates the degree of adult illliteracy of approximately 91% is unusually high compared to other rural areas. The 9% with 5-6 years of schooling are likely to have a knowledge of written Zulu and limited oral and written English. At the same time the levels of education and literacy among children are much higher.

The overall mean family size living at home was 7,22 persons, with a further 1,27 persons living away from home. Average family members living at home in the I group (6,31) was smaller than the N I group (8,29).

7.8.3 Socio-economic Characteristics

Thirty one per cent of heads of households were in some or other form of employment. Males and females were mainly employed in farming (52%). Other occupations included hawking and sewing for females, and labourer, carpenter and builder for males.

Table 7.4 Some socio-economic characteristics of household heads, Thukela Estates, 1998 (N = 67).

Characteristic	I (n = 36)		NI (n = 31)		Total (n = 67)	
	No.	%	No.	%	No.	%
Employed	18	50,0	3	9,7	21	31,3
Pensioners	18	50,0	25	81,0	43	64,2
Annual savings	3	8,3	4	12,9	7	10,4
Monthly household expenditure (R)	789,7 (S^2 710,6)		798,7 (S^2 534,2)		793,8 (S^2 630,5)	
Monthly expenditure on food	511,1 (S^2 365,9)		470,3 (S^2 291,8)		492,3 (S^2 291,8)	

The plight of non-irrigators is illustrated by the low employment rate of 10% compared to 50% for irrigators (Table 7.4). Approximately 50% of both I and NI households had sons and daughters in employment who may have contributed to household income in one way or another.

Eighty one per cent and 50% of the NI and I groups respectively had at least one member of the household in receipt of a pension, which in the majority of cases was the major source of oncome (Table 7.4)

Only one in ten households were able to save money (Table 7.4). For practical purposes monthly expenditure more or less equated with household income. There was no significant difference in household income between the two groups (Table 7.4). The current adjusted minimum subsistence level of a rural family of 7 persons is approximately

R1184 per month (Whiteford, Posel and Kelatwang, 1995). Only 13% of households in both groups had a monthly expenditure higher than the latter figure. Sixty two per cent of household expenditure was on food, which is a clear indication of an extreme poverty situation (Table 7.4).

7.8.4 Agricultural Production

7.8.4.1 Crops

The reliability of figures of crop production in Table 7.5 should be viewed with caution. Nevertheless it is clear that production levels are extremely low. It appears that some farmers who had irrigation water available did not utilise it.

Table 7.5 Value of crops for Irrigators and Non Irrigators (N = 67)

Variable	I (n = 36)	NI. (n = 31)	Total (N = 67)
	R	R	R
Value of crops when water available	203.55	161.93	174.62
Value of crops sold when water unavailable	186,11	96.77	154.14
Value of crops 1997/98	109.72	Nil	58.95
Value of crops sold 1997/98	59.70	Nil	32.08

The size of plot varied considerably. The average plot size was approximately 0,59ha.($S^2$0, 50). Sixty per cent of householders were allocated plots of 0,50ha or less (Table 7.6). Plots were designed to meet household requirements plus a surplus for sale.

Table 7.6 Distribution of households according to plot size (N = 67)

Plot size category	I		NI.		Total	
	No.	%	No.	%	No.	%
0,10 - 0,20	6	16,7	4	12,9	10	14,9
0,21 - 0,30	4	11,1	7	22,6	11	16,4
0,31 - 0,40	4	11,1	10	32,3	14	20,9
0,41 - 0,50	3	8,3	2	6,5	5	7,5
0,51 - 0,60	4	11,1	1	3,2	5	7,5
0,61 - 0,70	5	13,9	1	3,2	6	8,9
0,71 - 0,80	3	8,3	1	3,2	4	6,0
0,81 - 0,90	6	16,7	0	0,0	6	8,9
0,91 - 1,00	1	2,8	0	0,0	1	1,5
> 1,00	0	0,0	5	16,1	5	7,5
Total	**36**	**100,0**	**31**	**100,0**	**67**	**100,0**

The most important crops grown on the scheme in order of importance were maize, potatoes, sweet potatoes, beans, onions, tomatoes, butternut, cabbage and spinach.

On being questioned on crop preferences for the future, responses in order of importance were sweet potatoes, cabbage, potatoes, tomatoes, maize, spinach, butternuts, carrots, onions and beetroot. Sweet potatoes, maize, potatoes, onions, spinach and cabbage were perceived as the most profitable crops to grow.

7.8.4.2 Livestock

Cattle

The average herd size was 3 head. Only 8 per cent of households had more than 10 animals, which is the minimum required for a regular off-take.

Table 7.7 Distribution of households according to cattle herd size category, 1998 (N = 67).

No. of Cattle	I		NI		Total	
	No.	%	No.	%	No.	%
Nil	16	44,4	13	41,9	29	43,3
1 - 2	8	22,2	5	16,1	13	19,4
3 - 4	6	16,6	4	13,0	10	15,0
5 - 6	3	8,4	1	3,2	4	6,0
7 - 8	1	2,8	4	13,0	5	7,4
9 - 10	0	0,0	1	3,2	1	1,5
> 10	2	5,6	3	9,6	5	7,4
Total	**37**	**100,0**	**31**	**100,0**	**67**	**100,0**
Mean herd size		**2,61**		**3,55**		**3,04**

More than two in five (43%) of households did not own any cattle (Table 7.7). Only five head of cattle were sold over a twelve month period. There was virtually no integration of livestock with irrigated crops, except for animals grazing on crop residues.

Goats

Only 5,5% of participants owned any goats. Most herds were less than five head (Table 7.8).

Table 7.8 Household ownership of goats, Thukela Estates, 1998 (N = 67)

No. of goats	I		NI		Total	
	No.	%	No.	%	No.	%
Nil	14	38,9	16	51,6	30	44,8
1 - 5	15	41,7	9	29,0	24	35,8
6 - 10	5	13,8	4	12,9	9	13,4
11 - 15	2	5,6	2	6,5	4	6,0
Total	**36**	**100,0**	**31**	**100,0**	**67**	**100,0**
Average herd size	**3,53**		**2,58**		**3,09**	

Actual goat sales over a twelve month period were minimal (8head). Like cattle, goats serve as an investment and are used for home consumption, as well as for ceremonial slaughtering and lobola.

Other livestock

Only one household in the survey owned sheep. Broilers or laying hens were kept by 61% of householders entirely for home consumption. Only 9% kept more than 20 birds.

7.8.4.3 Implements, vehicles and tools

Only a minority of participants owned ox ploughs and cultivators, while the majority possessed hand tools such as spades and hoes (Table 7.9).

Table 7.9 Household ownership of vehicles, implements and tools, 1998 (N = 67).

Implement/vehicle/tools	I		NI		Total	
	No.	%	No.	%	No.	%
Ox plough	11	30,6	8	25,8	20	29,9
Ox cultivator	3	8,3	8	25,8	11	16,4
Ox planter	0	0,0	2	6,5	2	3,0
Bicycle	2	5,6	8	25,8	10	14,9
L D V	1	2,8	2	6,5	3	4,5
Motor car	0	0,0	1	3,2	1	1,5
Trailer	1	2,8	3	9,7	4	6,0
Hoes	36	100,0	31	100,0	67	100,0
Spades	29	80,6	29	93,5	58	86,6
Forks	13	36,1	24	66,6	37	50,7

Only four (6%) owned any type of motor vehicle which is in line with the low incomes and poverty pertaining in the area.

7.8.4.4 Labour

Most of the tasks of irrigation farming are carried out either by the wife on her own or by husband and wife together. Women make a major input into weed control, harvesting and marketing (Table 7.10)

Table 7.10 Household labour inputs on various tasks, Thukela Estates, 1998 (N = 67)

Task	Husband		Husband + wife		Wife	
	No.	%	No.	%	No.	%
Planting	9	13,4	35	52,2	23	34,3
Irrigation	21	31,3	23	34,3	23	34,3
Weed control	2	3,0	34	50,7	31	46,3
Harvesting	2	3,0	36	53,7	29	43,3
Marketing	9	13,6	26	39,4	31	47,0

Respondents were unanimous that weed control required the greatest labour input, followed by planting and harvesting. Seventy per cent of respondents hired local labour for one or more tasks. Because of the small size of holding the amount of labour hired in labour days per annum was low.

Table 7.11 Distribution of respondents according to hired labour days per annum, Thukela Estates, 1998 (N = 40)

Labour days category	No.	%
2 -30	24	60,0
31 - 60	6	15,0
61 - 90	4	10,0
91 - 120	1	2,5
121 - 150	2	5,0
> 151	3	7,5
Total	**40**	**100,0**

The average employment period was 26,88 labour days (S^2 45,91)

7.8.4.5 Land preparation

Only 16% of participants had adequate oxen to undertake their own ploughing. The remainder hired tractors. The majority (63%) appeared to be satisfied with land preparation services. This was probably becuase only a small proportion of land was being utilised.

7.8.4.6 Irrigation systems

The majority of participants had at least five years experience of irrigation. Sixty one per cent had more than 10 years experience. Forty three per cent were dissatisfied with the present sprinkler system, probably because the equipment was in a poor state of repair. The majority expressed a preference for flood and furrow irrigation. According to respondents there was a wide disparity in intervals between applications of irrigation water in summer.

7.8.4.7 Water quality, availability and charges

Only a minority of respondents (14%) perceived a problem with water quality. Probably due to breakdown of pumps, two-thirds (66%) of respondents perceived a problem of availability of water in the past. It was perceived that some farmers were getting more water than they should, while others were getting less. The majority of respondents (90%) were prepared to pay for water if charges were affordable.

7.8.5 Institutional Factors

7.8.5.1 Farming credit

Only about one in four (23%) of respondents had borrowed money for inputs and had been able to repay the loans. In the past loans for small-scale farmers have not been easily available.

7.8.5.2 Agricultural marketing

The majority of respondents perceived a problem with marketing of crops from the scheme, both from the point of view of low returns and a general lack of buyers.

7.8.5.3 Land tenure

The majority of respondents (77%), were dissatisfied with security of land tenure on the scheme. Thirty seven per cent perceived the need for title deeds, while others felt threatened by lack of control of animals due to the poor state of repair of the fencing. Farmers were divided on the adequacy of plot size allocated. Fifty four per cent were satisfied with the size of plot, while 46% felt plots should be larger. There was also divided opinion as to whether farmers should be permitted to sell or lease plots to others, with 52% having an affirmative opinion. Those not in favour felt tribal land should not be leased or sold. The majority (61%), expressed a wish to acquire more land.

7.8.5.4 Farmers' committee

Most farmers (78%) appeared to be satisfied with the Block Committees. Those dissatisfied with the Committees felt that they needed more training and should be

involved in acquiring ploughing services and rehabilitating the main canal system. There was general satisfaction (65%) with communication between block committees and the project management, as well as between the block committees and individual farmers (77%).

Farmers were almost unanimous (85%) that they should play a greater role in the management of the scheme, particularly in maintaining engines, pumps and canals, as well as working with with local extension staff.

7.8.5.5 Scheme management

Sixty three per cent of farmers appeared to be satisfied with the scheme management. Reasons for dissatisfaction included delays in providing water and services, lack of transparency, poor extension and lack of inputs.

7.8.5.6 Extension services

The majority of participants (83%) sought advice from local extension staff. A smaller number (17%) sought advice from the Block Chairman. In both cases the advice was perceived to be sound. The majority of participants (67%) preferred to have a male extension officer.

7.8.5.7 Farmer training

Fifty eight per cent of participants felt farmers were inadequately trained in irrigation farming. The major training needs were perceived to be in farm management and various aspects of crop management, including pest control. A need was also expressed for training in irrigation techniques, farm machinery and co-operatives. Individuals interviewed expressed a need for similar training, as well as in financial management and livestock.

7.8.6 Socio-psychological Factors

7.8.6.1 Scheme objectives

Perceived objectives of the scheme in order of importance were : to produce more food, increased income from crop sales and improved household income. Improved domestic water supplies were also mentioned. The general perception was that the scheme was established to provide food security and living standards, as well as provide employment.

7.8.6.2 Scheme rehabilitation

Participants' perceptions of needs to rehabilitate the scheme centred mainly on providing a more reliable water supply, as well as lining the main canal. Other needs mentioned were finance for farm inputs, as well as for fencing to keep cattle out of the scheme.

7.8.6.3 Farmer participation

As mentioned in 7.8.5.4 above, farmers were unanimous that there should be greater participation in the general running and maintenance of the scheme. This applied particularly to water distribution and allocation as well as to scheme financing.

The majority of participants (77%) felt that farmers should manage each Block themselves with assistance from the Department of Agriculture, especially in the initial stages.

7.8.6.4 Perceived problems

Understandably the most important perceived problem on the scheme concerned the provision of an assured water supply. Other problems mentioned were provision of adequate draught power, fencing off arable lands and improved management.

7.8.6.5 Conflicts

Besides internal faction conflicts which have been endemic within the community for many years, other perceived sources of conflict concerned water shortages, theft of crops, animals damaging crops and lack of farmer participation. Perceived solutions to conflicts included improved water reticulation and management, negotiations with community structures, and the hiring of security.

7.8.6.6 Farm decision making

The importance of wives in decision making is illustrated in Table 7.12. Wives have a great influence on all aspects of irrigation farming.

Table 7.12 Farm decision making, Thukela Estates, 1998 (N = 67)

Decision category	Husband		Husband/wife		Wife	
	No.	%	No.	%	No.	%
Crops to grow	25	37,3	15	22,4	27	40,3
Purchase of inputs	26	38,8	14	20,9	27	40,3
Labour inputs	17	25,4	18	26,9	32	47,8
Crop marketing	19	28,8	18	27,3	29	43,9
Household expenditure	18	27,3	15	22,7	33	50,0

7.8.6.7 Gender issues

On being questioned on the effects of the scheme on women, respondents felt there had been a heavier work burden (92%) on women; they had less access to land (86%) and had

become more dependent on their husbands, (72%), as well as having less income of their own (94%).

7.9 VIABILITY ASSESSMENT

To justify the investment in the rehabilitation of the scheme, it is useful to compare "with" and "without maintenance and rehabilitation". A wide range of obstacles need to be overcome, including conflicts within the community, upgrading infrastructure, low levels of productivity and a general lack of resources.

Only 30% of the productive area of the scheme is being used at present. Available evidence shown appallingly low levels of crop production (Table 7.5) and a situation of extreme poverty. Based on a cropping system of maize, legumes and vegetables, potential gross margins can be increased very significantly (Table 7.13). To achieve these gross margins will require an effective extension programme, together with other essential support services. The potential is unlikely to be achieved in the short term due to various human constraints such as low levels of education, literacy and management ability, as well as the age structure as discussed earlier.

Table 7.13 Estimated viability of rehabilitating Thukela Estates, 1999.

	Total	**per ha.**
Capital cost	7 741 084,85	14 523,61
Interest on capital @ 17%*	1 323 725.50	2 483.54
Gross margin on crops**		
Maize for sale (external)	2 203 955,00	4 135,00
Maize for sale (internal)	3 201 870,00	5 790,00

* Repayable over 30 years
**Based on 60% maize (7ton/ha), 20% legumes, 20% vegetables.

Farmer incomes are not such that they can afford to pay for the capital costs of rehabilitation, as well as high recurrent costs of scheme management, maintenance and water distribution. If the scheme is to be rehabilitated the interest and redemption on capital costs of rehabilitation will have to be fully subsidised. An element of subsidy on recurrent costs will also be required, initially at least, until an effective WUA is established.

The value locally of maize as a staple food is at least double that of the producer price. If maize is sold as "green mealies" an even greater gross margin is possible (Table 7.13). A potential gross margin of approximately R2800 per farmer (Table 7.13) could be increased substantially with the production of high value crops such as tomatoes, potatoes, cabbage and other vegetables. There is also a potential for citrus. However, for this to succeed an assured market is essential.

A particular problem on this scheme is the low level of literacy and a high proportion of widows and plot holders over 60 years of age, which has implications in terms of farmers' trainability to use improved technology to achieve optimum yields.

Gross margins in Table 7.13 are based on utilising the 533ha of Class A and B soils. If further investigations prove it is feasible to economically utilise the 280ha of Class C soils using sprinkler irrigation, then the scheme will become considerably more viable. If the scheme is to continue to operate it is important that there is dialogue with local structures to ensure that only *bona fide* committed farmers are allocated irrigation plots. Others need to be given the opportunity of a household food plot.

Taking into account the previous history of the project and the risks involved, the full rehabilitation of the scheme can only be justified on socio-political grounds as a poverty relief measure. The guidelines in 8.4 would need to be carefully adhered to.

7. 10. CONCLUSIONS

- A general conclusion is that a severe poverty situation pertains in the community. Poverty is a complex, multi-dimensional phenomenon arising from an interaction of income resources, institutional capacity and markets. The Thukela Estates community is very traditional with high levels of illiteracy. Although increased income and improved nutrition from agriculture is fundamental in alleviating poverty, institution and capacity building through increased participation are equally important.

- The key to poverty alleviation is to build a partnership between the community, the Department of Agriculture and the private sector.

- The scheme has been beset by problems of disunity and faction conflicts within the community, which have made previous efforts to rehabilitate the scheme extremely difficult and unsuccessful.

- There were no significant differences between those participants who were participating and those who were unable to utilise their irrigation rights in terms of personal and socio-economic characteristics, as well as in terms of resources. The latter were more reliant on income from pensions and understandably had no income from crops.

- The main canal system is in a poor state of repair and much of the above ground sprinkler system needs replacing.

- Since only 30% of the scheme is being utilised, the impact on poverty alleviation is extremely limited, particularly if coupled to the general lack of resources of individual participants.

- Data on crop production suggest that at present the scheme is producing at well below the potential.

- There is evidence that the water distribution system has not been functioning effectively.

- Despite the existence of the Tugela Estates Development Committee (TEDC) and Block Committee Farmers Associations, the degree of participation in the scheme has been low, which is one of the major constraints. There are also deficiencies of management and leadership skills within these structures.

- Marketing of surplus produce, as well as availability of farming inputs and adequate draught power are major production constraints.

- There is a general lack of knowledge and skills of management and irrigation both within local structures and among individual farmers.

- Disunity and conflicts within the community have made it extremely difficult for the extension staff of the Department to provide effective extension services.

- There is also evidence that extension staff themselves need further training in irrigation farming and management if they are to effectively fulfil their role.

- The majority of participants were dissatisfied with the security of land tenure on the scheme.

- A general conclusion is that considering most of the infrastructure is in place, the scheme is worth rehabilitating on socio-political grounds, provided the interest on capital is written off and the other essentials for rehabilitation are in place. It is pertinent to emphasize that to achieve the suggested gross margins will require considerable commitment and effort from the KNDA and the community as a whole.

7.11 RECOMMENDATIONS

⇒ Before any consideration is given to upgrading the infrastructure, it is essential to appoint a skilled facilitator to initiate dialogue on establishing a unified approach to farmer participation in the rehabilitation of the scheme from the planning phase onwards.

⇒ At the same time, it will be essential to formally constitute the Tukhela Estates Development Committee (TEDC) into a legally constituted Water Users' Association which together with the Block Committees can take over scheme assets, take out collective loans, operate accounts and institute bye-laws enforceable by its members.

The WUA to be responsible for management and maintenance of pumps, canals and all structures to field edge. The WUA would also be responsible for negotiating farm inputs, draught power and marketing.

⇒ It is recommended that initially the scheme be jointly managed by the WUA and the Department of Agriculture or its appointed agents, until such time as the WUA feels confident to take over all management functions.

⇒ It is recommended that the present Block Farmers Associations be formed into legally constituted Block Committees. The block committees to be responsible for water management and maintenance from field edge. Block Committees should have representatives on the WUA, and be responsible for extension services, ploughing services and input supplies in co-operation with the WUA.

⇒ It is recommended that the KwaZulu/Natal Department of Agriculture (KNDA) appoint suitable trainers to upgrade leadership and management skills of the WUA and Block Committees to maximise participation in the scheme rehabilitation process.

⇒ Because of the high levels of illiteracy it is recommended that the KNDA and the WUA negotiate with appropriate authorities to institute courses in adult functional literacy and numeracy.

⇒ It is recommended that KNDA ensure the appointment of suitable extension officers, as well as ensure that they are adequately trained and have the necessary subject-matter specialist back-up to provide sound advice and training to farmer participants in irrigation techniques and crop production.

⇒ It is recommended that extension officers on the scheme draw up extension programmes with Block Committees, specifying target groups and farming systems.

⇒ It is recommended that KNDA economists liaise with the WUA, Block Committees and researchers to undertake market research and assist in obtaining marketing partners for surplus produce.

⇒ It is recommended that the WUA and Block Committees negotiate with the community and the Department of Land Affairs to draw up secure land tenure systems acceptable to the community.

⇒ For efficient irrigation it is essential that the flood irrigation areas be levelled with a land plane and laid out according to the short-furrow method.

⇒ It is important to train tractor drivers in correct plough setting and ploughing techniques, especially in flood irrigation areas.

⇒ The scheme has the potential to produce a wide range of commodities. Recommended that the KNDA and appropriate research organisations initiate on-farm research in co-operation with Block Committees aimed at evolving suitable and acceptable farming systems.

⇒ Recommended that the KNDA and appropriate research organisations undertake investigations and trials aimed at developing techniques and technology for effectively utilising the Class C soils.

⇒ Recommended that the WUA liaise with the Land Bank to obtain credit for farming inputs for those farmers requiring it.

⇒ Recommended that the WUA and the KNDA negotiate with the Department of Water Affairs aimed at levying affordable water charges for the scheme as a whole and for individual farmers.

⇒ Recommended that the KNDA liaise with the WUA to solve the problem of draught power, as well as investigate minimum tillage systems.

⇒ A general recommendation is to only proceed with the rehabilitation of the scheme once the WUA and Block Committees have been formed and that there is general agreement on implementing the measures recommended above.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

A review of the available literature on small-scale farmer irrigation schemes in Africa revealed that little is known not only about the performance of schemes, but there is also relatively little dissemination of information about experience gained, which would be useful in planning new schemes and rehabilitating and modernising existing schemes. Despite huge investments, the performance of most small-scale farmer schemes in South Africa, other than sugar cane schemes in KwaZulu-Natal and Mpumalanga, has been poor. Available research supported by this study has shown that these schemes are beset by varying combinations of economic, institutional and social problems.

The methodology used in this study, comprising a combination of in-field observations, structured group discussions, individual household interviews and available literature proved to be a useful approach in evaluating the constraints and needs of the four case study schemes. These schemes all fell into the predominant category of *top down* bureaucratically managed schemes in South Africa. The approach to the research was essentially participatory from the initial planning stage right through to report back meetings on the findings to participants and Departmental staff.

8.2 SMALL-SCALE FARMER SCHEMES IN THREE PROVINCES

A postal questionnaire survey carried out by staff of the Agricultural Departments in the Eastern Cape, KwaZulu-Natal and the Northern Province identified 147 schemes comprising 28,369ha under irrigation. These schemes had a total of 37 864 participants and a population of approximately 227 184 persons. Unfortunately up-to-date information was not available from the Northern Province. The study revealed a host of problems and constraints, including water reliability and reticulation problems, deterioration of physical infrastructure, institutional and management problems, as well as socio-economic constraints. All these constraints resulted in considerably below optimum levels of production. As a generalisation the sugar cane schemes funded by the Department of Agriculture in KwaZulu-Natal tended to be more successful than other government funded schemes. This was largely due to better support services and a readily available market.

For the purpose of this study, "commercial farmers" being defined as those with plots of one or more hectares, 25 per cent, mainly in the Northern Province, could be classed as commercial farmers. However, it should be recognised that there is no clear cut division between so-called food plots and commercial farmers. It should rather be seen as a continuum from part-time subsistence to full-time commercial farming. Food plots can

become commercially orientated, if participants are keen and enthusiastic and able to manage their plots efficiently.

Because of financial constraints, as well as in some instances, the complete withdrawal of management and finance by Agricultural Departments over the past five years, many small-scale farmer irrigation schemes in the three provinces have deteriorated and others have collapsed. Irrigation equipment has deteriorated, and inputs and efficiency are low, resulting in low levels of productivity. The latter varied considerably between individuals.

Problems and constraints on larger schemes (>50ha) tended to centre around poor maintenance of infrastructure and equipment, high energy costs, lack of institutional support in terms of credit, marketing, and draught power, lack of extension and farmer training, as well as local conflict and weak local organisations. Problems of soil and water salinity also occurred.

On the smaller schemes, problems were of a similar nature, with somewhat less emphasis on poor maintenance of equipment and infrastructure. On some of these schemes, theft and animals causing damage to crops, as well as local and political conflicts were cited as constraints.

Understandably, the need to upgrade infrastructure and equipment on all schemes was perceived as the major need to modernise and rehabilitate projects. Other needs include conflict resolution, farmer training, greater farmer participation, and improved training of extension workers. Security of land tenure and improved markets were also mentioned as important needs on larger schemes. On the smaller schemes there was a particular need for improved fencing to prevent animals causing damage to crops, as well as provision of farm inputs and greater farmer participation.

In Kwazulu-Natal some 40% of schemes were based on sugar cane production which has a ready market. On the other schemes in the three provinces a wide range of crops and vegetables were produced. Maize was invariably the main staple food crop. Crop yields on the sugar schemes were reasonable, although there were a number of farmers with poor management, especially inadequate weed control resulting in uneconomic yields. On other schemes yields were extremely variable due to lack of resources, including inputs and credit, as well as low levels of management and poor irrigation and crop farming techniques. In the Eastern Cape and KwaZulu-Natal a large percentage (circa 70%) of participants on non sugar schemes achieved yields considerably below potential for the previously mentioned reasons.

Data from this survey leads to the conclusion that successful small-scale farmer irrigation schemes depend on integration between technology, management, participants and the socio-economic situation. Lessons which can be learnt from the current situation based on the four case studies are discussed below.

8.3 THE SCHEMES COMPARED

8.3.1 Physical Resources and Infrastructure

Detailed evaluations of the four schemes were given in Chapters 4 to 7 and will not be repeated here. The original objective of Tyefu, Bululwane and Thukela Estates was to provide for food security, as well as income to improved living standards. The Sekgakgapeng scheme and 29 plots on Tyefu were designed to wholly or partly support farm families. On all schemes, except possibly with specialised crops on Tyefu, plot sizes are inadequate to derive an income solely from irrigation farming (Table 8.1).

Table 8.1 Comparative data on physical resources, infrastructure and water supplies.

VARIABLE	SCHEME			
	Tyefu	**Segakgapeng**	**Bululwane**	**Thukela Estates**
Scheme objective	Food-income	Income	Food-income	Food-finance
Irrigated area ha.	644,0	28,0	345,0	813,0
Commercial farmers[1] No.	29	14	35	Nil
Food plots No.	1486	Nil	305	1275
Plot size ha.	0,16 - 4,00	2,00	0,40 - 1,20	0,16 - 0,80
Climate for irrigation	Good	Good	Good	Good
Soils	Fair-good	Fair	Fair-good	Fair-good
Drainage	Fair	Fair	Fair	Fair-good
Water quantity	Fair	Good	Fair-good	Good
Water quality	Fair	Fair	Fair-good	Good
Water delivery	Pumping	Pumping/BH	Gravity	Gravity/pumping
Energy source	Electricity	Electricity	N/A	Electricity
Irrigation infrastructure	Poor-fair	Poor	Fair	Poor
Irrigation technology	Sprinkler	Centre pivot	Gravity furrow	Gravity-sprinkler
Access roads	Good	Good	Fair	Good
Rehabilitation needs	Pipeline+ infrastructure	Dragline + solid set sprinkler	Canals, storage dams	Canals - infrastructure
Rehabilitation viability[2]	Good (34-66%)	Good[3]	Good (42-145%)	Good(66-142%)

[1] Plots larger than 1,0ha

[2] Rated on potential gross margin ratio to interest and redemption on rehabilitation costs.

[3] Dependent on water quality

Although there is a degree of risk of winter frosts on all schemes except Bululwane, the climate is such as to permit the growing of two crops per year.

Marginal irrigable soils occur in areas commanded by irrigation on Tyefu, Bululwane and Thukela Estates. On Bululwane and Thukela Estates water logging has occurred due to improper drainage and over irrigation. On Sekgakgapeng salt water intrusion from boreholes has caused a build up of salts. *It is important that further trials and investigations be carried out on marginal soils aimed at optimum use of those soils.* Viability assessments are based only on utilising good irrigable soils. If these soils prove to be suitable, the viability of the schemes becomes much more favourable.

High salinity has proved to be a problem on the Tyefu and Sekgakgapeng schemes. On Bululwane water was considered "too pure for irrigation" and could cause soil permeability problems. There have been problems of water shortages on Tyefu during droughts. However, by using Orange river water this problem can be overcome. Except for Sekgakgapeng, none of the schemes produced a positive cash flow in the past, even in the operational sense.

The viability of modernising or rehabilitating schemes was based on the assumption that there would be no capital and redemption costs charged against existing infrastructure. On the assumption that projected gross margins based on optimum yields are achieved, the schemes would theoretically justify rehabilitation (Table 8.1). In practice, however, due to human constraints such as age, education and lack of skills, these projections are unlikely to be achieved in the short to medium term. Furthermore, gross margins would not only go to paying off loans, but also for other household obligations. A general conclusion is that rehabilitation can only be justified on socio-political and poverty alleviation grounds. In addition, successful rehabilitation depends on certain institutional reforms and operational support services as discussed in 8.4 below.

8.3.2 Personal and Socio-economic Characteristics of Scheme Participants

More than one in five households were headed by widows who were particularly disadvantaged in having to cope not only with agricultural activities but also with family and household tasks. It was found that in all four schemes women play a key role in household decision making, as well as on labour inputs in all phases of crop production. There is a need to integrate more women in scheme management in order to increase women's benefits from projects and to ensure greater participation.

Approximately two in five heads of households were over 60 years of age and at a stage of life where they were unlikely to be motivated and physically active to achieve high levels of production. Of particular concern was the high level of illiteracy, especially on Thukela Estates (Table 8.2). It is well known that education is an important motivational factor. However the next generation were invariably better educated that their parents.

Because of the large proportion of heads of households in the upper age groups and low levels of literacy and education, it can be concluded that the present capacity of heads of households to absorb and implement new technology of future development initiatives of the case study irrigation schemes are somewhat limited. However, this may change over time as younger people take over, as well as with land reform initiatives. In order to encourage younger people to participate in irrigation schemes, consideration will need to be given to viability of farming units, secruity of tenure and institutional support as detailed in 8.4 below.

Table 8.2 Personal and socio-economic characteristics of scheme participants

Characteristic	SCHEME			
	Tyefu	Sekgakgapeng	Bululwane	Thukela Estates
PERSONAL				
Widowed households%	30,4	21,4	15,0	20,9
Age > 60 years%	37,0	71,2	42,5	33,4
Illiterate %	56,5	63,9	57,7	91,0
SOCIO-ECONOMIC				
Monthly expenditure(R)	769,02	965,00	706,25	793,8
Expenditure on food (R)	453,59	625,70	486,25	492,3
% saving money	2,8	7,3	42,5	10,4
% pensioners	62,8	47,1	60,0	64,2
% below P D L	74,9	65,0	50,0	86,0
Employed heads	36,1	14,3	22,5	31,3
Labour availability	Good	Good	Good	Good
Farmer selection	Tribal authority[1]	Tribal authority	Tribal authority	Tribal authority
Cattle herd size	1,5	0,60	4,82	3,04
Goat herd size	5,7	0,50	5,9	3,09
Ox ploughs %	12,7	42,9	32,5	29,9
Tractor No.%	4,3	14,3	2,5	Nil
Water charges	C F R100 p.a	Nil	Nil	Nil
Crop value (R)[2]	3172,72[3]	R5716.00	R832,35	R174,60

[1] C Fs selected on potential
[2] When irrigation available
[3] C Fs R9290, FPHs R746

An important consideration in deciding whether or not to modernise or rehabilitate small-scale farmer irrigation schemes is the socio-economic situation. Both household incomes and savings were low on all schemes. The high percentage of expenditure devoted to food is an important poverty indicator. A large percentage of household income was derived from pensions. The majority of households were estimated to be living below the poverty datum line, and this was particularly serious on the Tyefu and Thukela Estates schemes. Employment levels were also low (Table 8.2).

Although farmers' managerial ability was not specifically investigated, indicators such as low levels of education, literacy and numeracy, as well as low levels of production confirm low levels of managerial ability as a serious constraint which needs to be overcome in successful rehabilitation of all schemes.

Except for the commercial farmers on Tyefu and those in Sekgakgapeng, there was no farmer selection on merit, since the schemes were designed to alleviate food shortages and supplement household income. Scheme participants had very limited resources in terms of livestock and implements. Except for the commercial farmers on Tyefu who paid a nominal annual charge of R100 for water, irrigation water was provided free of charge. Despite this, except for the commercial farmers on Tyefu and Sekgakgapeng, crop

production income when the schemes were fully functioning was considerably below potential and did not contribute greatly to household income (Table 8.2).

8.3.3 Community and Farmer Perceptions

Perception is the interpretation or meaning of a situation from the point of view of an individual and is based on his/her past experience. From the stand point of modernising or rehabilitating irrigation schemes, it is clear that without a knowledge of community perceptions change may be impeded, particularly if the community has different perceptions to those of the development agency. On the other hand, communities are more likely to accept change if development agencies adapt transformation to the perceptions of local communities. At the same time it should be realised that there are often misperceptions on certain issues, which can be corrected by effective communication.

Table 8.3 provides a summary of participants and non participants' perceptions on various issues. In the case of Tyefu, Bululwane and Thukela Estates virtually the whole community was involved in the scheme in one way or another. Sekgakgapeng is a good example where failure to integrate the scheme in the local community can result in disastrous results; in this case sabotage of the irrigation infrastructure and equipment. Clearly the solution lies in greater community participation in the scheme (Refer 5.11)

Scheme participants and non participants were well aware of the original objectives of the schemes which centred on food security and additional income for food plot holders, and to provide a living for commercial farmers on Tyefu and Sekgakgapeng. Improved knowledge and skills were also perceived as objectives on Tyefu and Sekgakgapeng.

Perceptions were divided on the overall impact of irrigation schemes, depending on how the individual had benefitted. The present situation of closure or partial disfunctioning of schemes obviously had a negative impact. Opinions on the satisfaction with past management were also divided. It goes without saying that the withdrawal of management from Tyefu and Sekgakgapeng is a cause of great dissatisfaction.

Respondents on all schemes were unanimous that the schemes should be rehabilitated. There were divided perceptions on the functioning of local farmer committees on the schemes. On all schemes there was a very positive attitude to greater farmer participation in both the future running and maintenance of the scheme. However, on Tyefu and Thukela Estates there are serious conflict situations which need to be resolved before any action can be taken on modernisation and rehabilitation.

Perceptions were unanimous that women should have greater participation in decision making, management and maintenance of schemes.

Table 8.3 Scheme participants' perceptions of various variables according to schemes.

Variable	SCHEME			
	Tyefu	Sekgakgapeng	Bululwane	Thukela Estates
Scheme objectives	Food, income, skills	Income/food	Food, income, security	Food, security/income
Scheme impact	Divided opinion	Only farmers	Positive	Divided opinion
Scheme management	Majority satisfied	Farmers satisfied	Divided opinion	Some satisfaction
Farmer selection	Some dissatisfaction	Farmer plot holders	No problem	No problem
Scheme rehabilitation	Positive	Positive	Positive	Positive
Scheme conflicts	Farmers Unions	Community/farmers	Land issues	Faction conflicts
Role local committee	Divided opinion	Divided opinion	Satisfaction	Most satisfied
Participation in management	Positive	Positive	Positive	Positive
Participation in maintenance	Positive	Positive	Positive	Positive
Gender issues	Greater participation	Vital role	Vital role	Greater involvement
Political support	Divided opinion	Limited	Adequate	Inadequate
Crop systems	More diversification	Satisfied	Need diversification	Need dversification
Land tenure	Dissatisfied	Dissatisfied	Satisfied	Dissatisfied
Extension	Dissatisfied	Reasonable	Reasonable	Poor
Training	Inadequate	Training needed	Training needed	Inadequate
Markets	Inadequate	Inadequate	Major problem	Major problem
Credit	FPs dissatisfied	Available	Lacking	Lacking
Irrigation systems	Some dissatisfaction	Dissatisfied	Satisfied	Dissatisfied
Irrigation technology	Dissatisfied	Dissatisfied	Satisfied	Dissatisfied
Water charges	Positive	Positive	Positive	Positive
Livestock in scheme	Majority dissatisfied	Farmers satisfied	Divided opinion	Some dissatisfaction

Political support is vital if any scheme is to be sustained. Except for Bululwane, where King Zwelitini exerts a major influence, perceptions were divided on the extent of political support on individual schemes. *This points to the need for consultation with all levels of leadership in formulating rehabilitation plans.*

Although there was no particular dissatisfaction on present cropping systems, a number of participants expressed an interest in greater diversification of crops and vegetables. Any such changes will obviously have to go hand in hand with the provision of markets, credit, training, research and extension, all of which were perceived as inadequate (Table 8.3). the issue of dissatisfaction with present land tenure security can only be solved by the community itself in consultation with the Department of Land Affairs.

Irrigation systems and irrigation technology are important issues to be fully investigated in conjunction with any rehabilitation programmes. For example, the centre pivot system in

Sekgakgapeng is not suited to individual choice of cropping programmes and often breaks down due to lack of maintenance.

The universal problem of livestock causing damage to crops can only be solved by the local community structures themselves in co-operation with effective fencing arrangements to protect irrgated crops.

8.3.4 Institutional Support

8.3.4.1 Project management

It is evident that past discrimination has resulted in small-scale irrigation schemes receiving poor support services. Previous services were top down, focussing on production rather than people. It is largely due to the neglect of the human factor and lack of participation that the schemes have become non-viable.

Case study investigations showed little evidence of performance responsive management being undertaken by project management staff. Operational and maintenance rules tend to be routine rather than made in response to field conditions. The past performance of the four case study projects has been well below expectations, producing low economic returns. In earlier years commercial farmers on Tyefu showed promise of good returns, especially when accompanied by organised marketing.

The lessons of past experience on these schemes suggest a decisive break from past policies to embrace a new approach that is comprehensive, market oriented, participatory and sustainable. Past management arrangements precluded successful human resource and entrepreneurial development. Scheme managers have been attempting to "manage" farmers rather than encouraging entrepreneurial development. Water supply management is a problem on all four schemes. Conveyance systems have deteriorated and broken down over the years and much water is wasted.

Table 8.4 Institutional support services according to scheme

INSTITUTIONAL FACTOR	SCHEME			
	Tyefu	**Sekgakgapeng**	**Bululwane**	**Thukela Estates**
Project management	Previously parastatal	Dept. of Agric.	Dept. of Agric.	Dept. of Agric.
Farmers organisations	Weak	Weak	Fair	Weak
Extension	Weak	Fair	Fair	Weak
Research	None	None	None	None
Training	Inadequate	Inadequate	Inadequate	Inadequate
Markets	Previous contracts CFs No organised markets	No organised markets	No organised markets	No organised markets
Credit	Mainly C Fs	Previously available	Limited	Limited
Inputs	Limited availability	Readily available	Limited	Limited
Mechanisation	Discontinued	Local contractors	Govt. tractors + cattle	Govt. tractors
Land tenure	Communal	Communal	Communal	Communal

8.3.4.2 Farmers' organisations

If support for increased agricultural production on irrigation schemes is to be effective, then institutions offering support services need to have strong institutional support at the local level. Although there were farmers' organisations on all four schemes,they have not been effective due to lack of training and participation in the overall running of the schemes. On Tyefu and Thukela Estates conflicts between rival farmers associations and factions respectively have negated their impact.

Farmers are poorly organised in terms of common lobbying, providing inputs and marketing produce. There was generally a lack of joint initiative for the benefit of the scheme as a whole.

Present farmer organisations are not capable of using members' own resources to optimally manage schemes themselves because of the limited financial and human resources and capabilities available. There is a dire need to develop and train local leadership and organisations. The inter-dependence in terms of organisational autonomy in decision making, and bargaining power is lacking. They have been dependent on support services to make decisions.

Generally there are few examples of viable self-help organisations on small-scale farmer irrigation schemes that have been created by the spontaneous initiative of rural people themselves. To succeed they need motivation, stimulation, training, advice and support from outside.

8.3.4.3 Extension services

A survey of extension officers involved in two of the case study schemes revealed that extension officers themselves perceived the need for further training in a wide range of topics. The majority also rated their competence to give advice to be lacking in some respects. This was borne out by the low achievement in a simple test on irrigation scheduling and water application (Refer 4.8). There is a general lack of specialised extension workers who can advise farmers on crop production techniques, as well as water management and application.

At present extension workers appear to have no accountability to people and communities. Accountability, if any, is entirely within Departmental line functions. Usually accountability is in terms of activities rather than on impact on farmers. The key to successful extension lies in targeting within communities and accountability. Because they are often poorly trained to support irrigation schemes, extension officers often feel inadequate in their important role and are often not respected by irrigation farmers.

8.3.4.4 Agricultural research

The agricultural research system in South Africa is relatively well developed. However, inadequate attention is given to the problems of small-scale farmers on irrigation schemes. If the latter schemes are to be developed to their full development potential, on-farm agricultural research needs to be considerably strengthened. Other than earlier crop trials on the Tyefu irrigation scheme, there has been virtually no research or experimentation carried out on the case study schemes.

8.3.4.5 Training

Clearly farmers on irrigation schemes do have some knowledge and experience of irrigation farming. In many cases there was a serious lack of interaction between farmers and extension workers. This was aggravated by internal conflicts on two of the schemes.

Skills to be learnt go further than crops and irrigation. There is also a need for farmers to be *au fait* with institutional arrangements, inputs, marketing and labour requirements. Few farmers, and for that matter, extension workers, have an understanding of irrigation scheduling and management, as well as in-field water use efficiency.

The lack of adequately trained extension and management personnel to implement rehabilitation and modernisation programmes is a serious constraint. There is a need for transformation of current attitudes and technical know-how and reform in training extension workers to produce sensitive, effective professionals for the future.

8.3.4.6 Markets

A major constraint to increasing overall income on the schemes is a ready access to markets (Table 8.4). There is a need for market oriented production combined with processing, distribution and marketing, particularly on the larger schemes. This will reduce food losses, improve nutrition and stimulate production. There is a need for an intermediary to put farmers in touch with marketing agencies. Marketing agencies can also deal with inputs and farming credit.

8.3.4.7 Agricultural credit

Although commercial farmers on Tyefu and Sekgakgapeng had access to credit, the majority of foodplot holders were unable to obtain credit due to lack of security. More recently this has been overcome by the Land Bank's new policy to provide credit access to small-scale farmers with proven ability. There is a need for easier credit access to women farmers.

8.3.4.8 Agricultural inputs

The lack of credit facilities precluded many food plot holders from obtaining adequate inputs. Distances from sources of supply and transport were also constraints to input supplies.

8.3.4.9 Mechanisation

Efficient irrigation is only possible with optimum yields, which in turn requires timely available ploughing services or draught power. Mechanisation services have in the past been supplied by the Department of Agriculture on a subsidised basis. This has not always proved satisfactory due to breakdowns and inability to service all farmers timeously. In some cases, private contractors have been available, but the small size of plot and widely dispersed plots does not make this very attractive economically. There is a need to investigate and encourage animal traction and the combining of animals with small muti-purpose tractors, such as those used in some Far East countries.

8.3.4.10 Land tenure

With the exception of commercial farmers on Tyefu who were allocated 4ha, the general plot size of one hectare or less is too small to make a living. Furthermore, the present land tenure system does not permit individuals to acquire larger holdings. There is a need for a mechanism to adjust plot size to household capacity. The present system of insecure communal tenure is a disincentive for owners to invest in their plots. It prevents poor farmers from selling or leasing, and more progressive farmers from acquiring more land.

This study has shown that it is essential that the issues of land security be addressed by local communities together with the Department of Land Affairs. Ideally individual property rights should be able to change hands and provide collateral for loans.

8.4 GUIDELINES FOR SCHEME REHABILITATION

8.4.1 Introduction

The overview of schemes in the three Provinces, as well as the four case studies show that, with the exception of a few sugar cane schemes in Kwa Zulu Natal, many of South Africa's small-scale farmer irrigation schemes are in a state of crisis. The near or complete collapse of schemes due a combination of lack of funding, poor management and maintenance of infrastructure, leading to low productivity and poverty are all part of the same fundamental problem : inadequate and inappropriate organisation.

It is important to realise that irrigation is not a panacea to solve the problems of the rural poor. As shown in the case studies, if not used properly it can lead to high levels of debt

and hence increased poverty. Conversely, if well managed and integrated with regional rural development, irrigation farming can considerably enhance food security, alleviate poverty and provide employment.

Schemes already in place have the advantage that the basic infrastructure and water supply is in place and that the farmers are familiar with irrigation farming and have developed at least some basic skills, which can be further developed through on-farm extension and training. In many such schemes there is a need for both rehabilitation in the sense of renovation of a scheme to meet its original design criteria, as well as modernisation to meet new criteria. The orientation of Agricultural Departments and a change in their bureaucratic procedures in a decentralised direction is a necessary condition for a move towards increased productivity and farmer participation.

While there is some literature available on the design of new small-scale farmer irrigation schemes in Africa (Ubels and Hurst, 1993; UK Department of International Development (DFID), 1998), there is little documentation on guidelines for the rehabilitation of such schemes.

Scheme rehabilitation can be defined as a process of improving a collapsed or near collapsed inefficient irrigation scheme after full diagnosis and investigation of resources such as water, land and human resources, and redesigning *wherever necessary* the infrastructure of the scheme to meet the current and *foreseeable* future requirements, as well as providing the necessary back-up services. These include cropping systems and improving institutional and organisational arrangements for operation and maintenance with beneficiary participation at all levels to meet the ultimate objectives of the scheme (Kamaladasa, Samarasekara and Azharul Haq, 1995).

Based on the findings of the case studies, what follows is a discussion on a series of general guidelines aimed at rehabilitating small-scale farmer irrigation schemes. A common thread amongst the case studies is that there has been very little evidence of concern for long-term stability of irrigated agriculture.

8.4.2 Rehabilitation guidelines

The process of rehabilitation planning and modernising is complex and diverse. It is difficult to provide definitive guidelines. No two schemes are the same. However, there are certain basic elements which should be considered. These include the need for pre-feasibility studies to establish constraints, potential and viability such as in the case studies outlined in chapters 4 to 7.

For successful rehabilitation there is a need for structural reform to move away from traditional approaches to new approaches which will ensure effective support for local irrigation farmers and local institutions. It requires a transformation of current attitudes in management and technology as well as reform in farmer participation and training of farmers and extension workers. Table 8.5 provides a check list of issues to be considered

in rehabilitating and modernising small-scale farmer irrigation schemes which are discussed below.

Table 8.5 A check list of guidelines for rehabilitating and modernising small-scale farmer irrigation schemes

FACTOR	REMARKS
1. **SOCIO-ECONOMIC**	
1.1 Farmer characteristics	Personal, socio-economic and socio-psychological
1.2 Age - marital status	Encourage youth; female headed disadvantaged
1.3 Education - literacy	Functional literacy and numeracy
1.4 Managerial ability - experience	Management training
1.5 Gender issues	Role of women in irrigation
1.6 Health	Water borne and nutritional diseases
1.7 Labour	Availability of labour
1.8 Perceptions	Rehabilitation needs
1.9 Land ownership/tenure	Security of tenure - negotiability of land rights
2. ENVIRONMENTAL ASPECTS	Water pollution, soil erosion
3. TOPOGRAPHY AND SOILS	Soil survey - marginal soils
4. AGRICULTURE	
4.1 Land-use, farming systems	Present and potential farming systems and production
4.2 Climate	Suitability for crops and vegetables
4.3 Constraints	Assess production constraints
5. MARKETING	Present and potential markets
6. WATER SUPPLIES	Reliability and quality
7. IRRIGATION INFRASTRUCTURE	Suitability and costs
5. MARKETING AND INFRASTRUCTURE	Present and potential markets
6. WATER SUPPLIES	Reliability and quality
7. IRRIGATION INFRASTRUCTURE	Suitability and costs
8. ECONOMIC INDICATORS	Assess rehabilitation viability
9. SCHEME REHABILITATION OPERATION AND MAINTENANCE	
9.1 Farmer participation	Participation in management, operation and maintenance
9.2 Water Users' Associations	Guidelines for formation of WUAs
9.3 Upgrading infrastructure	Costs and suitability
9.4 Operation and maintenance	Community participation
9.5 Credit availability	Selective credit
9.6 Inputs	Availability
9.7 Mechanisation	Mechanisation services, draught power
9.8 Farmer training	Extension and training
9.9 Research	On farm reserch

Sustainable irrigation rehabilitation should be integrated as part of the whole process of area and regional rural development. This involves a range of role players, including local government, traditional leaders, provincial and national government departments, educational authorities, credit agencies, input suppliers, marketing agencies, Water Users' Associations (WUA's), and farmers, as well as irrigation technical expertise, all of whom should be consulted from the pre-planning plase onwards.

Farmer managed schemes can only be effectively rehabilitated through participative planning and implementation, as well as in scheme construction, maintenance and

management. Any rehabilitation programme should be conditional in establishing a formally constituted WUA and the appointment of a Facilitator from the pre-planning stages onwards (Refer 8.4.11.2).

Crosby, de Lange, Stimie and Crosby (1998) provide useful guidelines to planning and design of small-scale farmer irrigation projects. Their report deals with feasibility studies, participatory irrigation planning, managing crop water requirements, water supply management, pressurised irrigation systems, flood irrigation, community gardens, project rehabilitation and training.

8.4.3 Socio-economic Factors

A thorough understanding of the socio-economic situation is an essential pre-requisite for scheme rehabilitation. This does not necessarily require a detailed survey. Results of the case studies have shown that adequate qualitative information can be obtained by consulting with leaders, key informants and representative groups of scheme participants and non-participants.

8.4.3.1 Farmer characteristics

The case studies have shown the importance of obtaining a clear idea of the demographic, socio-economic and socio-psychological characteristics of scheme participants, and where applicable, non-participants in the local community. It is important to determine the appropriateness of rehabilitation in the context of personal, socio-economic and socio-psychological characteristics of scheme participants and in some cases potential participants.

- **Personal characteristics**
  After identifying key informants and local groups, it is important, through structured interviews, to establish approximations of the marital status, age structure, education and literacy levels of scheme participants - all factors which have a bearing on successful rehabilitation and participation.

- **Age structure**
  Older, less educated farmers may have difficulty in assimilating irrigation and cropping technology, as well as undertaking labour intensive tasks. Evidence in this study showed a skewed distribution towards the older age groups as a major constraint.

- **Education and literacy**
  The degree of literacy affects farmers' ability to absorb new technology. Possibilities of instituting functional literacy and numeracy training need to be investigated.

- **Managerial ability and experience**
  Farmer training in crop and irrigation water management, as well as financial management are key factors in successful scheme management. The latter should, if possible , be accompanied by functional numeracy and literacy training.

- **Youth**
  Future scheme viability will depend on creating conditions to attract younger people to participate in schemes. The current situation of low income, small size of holding and lack of security of tenure are all issues which need to be addressed to attract younger scheme participants.

- **Gender issues**
  Many agricultural tasks are undertaken by women, who are increasingly becoming more involved in household decision making. Women often bear heavy work loads which may present a constraint to agricultural production. Widowed heads of households are particularly disadvantaged.

- **Poverty indicators**
  Socio-economic poverty indicators such as employment, household expenditure, expenditure on food, savings, income sources, and resources can be established through structured interviews with key informants and local structures. These variables are all good indicators of the degree of poverty. On large schemes, it may be worthwhile to undertake a stratified sample survey to establish these parameters.

- **Labour**
  The whole question of labour availability should be explored with participants. The division of rights and obligations on labour and decision making needs to be taken into account. On average, the labour requirement for cereals and horticultural crops is approximately 5 workers per ha. of crops. It is important to assess demands for labour at peak periods, including casual labour. Hired labour is likely to be drawn from the local community.

- **Health**
  Local clinics can often provide a good indication of the general state of health on the scheme.

- **Perceptions**
  It is important to establish through structured interviews the general perceptions on scheme rehabilitation and needs. Negative perceptions can sometimes be changed through dialogue. However, it is important that there is a consensus among participants not only on whether the particular scheme should be rehabilitated, but also the needs and requirements for successful rehabilitation.

- **Land tenure**
  Case studies have shown that irrigation development is often superimposed on existing tribal systems of communal land rights. The current system of insecure land rights is a disincentive for farmers to invest in land improvement.

  The results of the study have shown that the economics of small-scale farmer irrigation is limited by the small size of holding. There is a need to create opportunities for poor farmers to make way for high performers on a compensatory basis. Pensioners and those not intested in larger holdings could be compensated by setting aside a block of small food gardens for those interested in producing food for the household.

  There is a need for a facilitator to act as a catalyst in assisting communities in deciding the most appropriate system of land tenure in conjunction with the Department of Land Affairs.

  Rehabilitation of irrigation schemes may require changes in land tenure, including land consolidation to achieve economies of scale, as well as providing collateral security for farming loans. To be acceptable, any changes in land tenure must be developed in consultation with local structure, especially the tribal authority in consultation with the Department of Land Affairs. Where the local community cannot agree on a land reform policy, there must be doubt as to their ability to work together in operating and maintaining the scheme.

- **Constraints**

On completion of the socio-economic survey it is important to carefully consider the above characteristics and determine the likelihood of overcoming constraints through training and assistance which may support or otherwise efforts to rehabilitate the scheme concerned.

8.4.4 Environmental Aspects

It is important to recognise any potential negative impacts on the natural environment, such as soil erosion, destruction of vegetation, water pollution and water borne diseases. The latter is particularly important on flood irrigation schemes.

8.4.5 Topography and Soils

The case studies have shown considerable variation in soils on individual schemes as well as the importance of establishing the suitability of soils and climate for intensive irrigation.

On schemes where marginal soils exist, the use and potential of such soils should be fully investigated before implementation of a rehabilitation programme.

- Where no soil survey data and information is available, cognisance should be taken of various reports from similar areas.

- Even where soil surveys and analyses have previously been undertaken, it is important for a soil scientist to re-evaluate the soils which may have deteriorated due to over-irrigation and unfavourable water quality.

- It is important to recognise any soil properties, physical and chemical, which may make the soils marginal for irrigation, or require special measures and agronomic and irrigation techniques to make production economically sustainable. Especially where flood irrigation is practised, land planing may be necessary.

8.4.6 Agricultural Production

8.4.6.1 Land-use and farming systems

A farming system is made up of the food and cash earning activities of a farming household. Irrigation is only one activity. The unit of production may not be same as the unit of consumption.

A knowledge of present cropping patterns, including inputs, yields and constraints is important for future planning and rehabilitation. As shown in the case studies, there is often very little reliable information on crop yields, especially from schemes which have ceased to function. Local observations by extension staff, nearby commercial farmers and subject matter specialists can often provide a useful guideline on the gap between present and potential yields as a basis for assessing viability.

- The success of the present and proposed cropping programme will depend not only on agronomic and marketing factors, but also on issues of food security, income needs and the importance of irrigation in the household farming system. Discussions with WUAs on these issues will assist farmers to focus on their real needs.

- On large schemes the cropping programme should make allowance for a break in irrigation of approximately one month, so that the water distribution system and irrigation equipment can be shut down for maintenance.

- Livestock may play an important role in the local economy. Integration of livestock with irrigated crops may be important for the provision of animal traction and manure, as well as improved animal nutrition through use of crop residues and possibly grain for livestock fattening and dairy production.

- It is important to assess farmer resources in terms of available equipment and tools for irrigation farming.

8.4.6.2 Climate

In order to establish the suitability of present and proposed crops, information is required on temperature, rainfall and consumptive use of water through available data.

- If data is unavailable it may be necessary to transpose data by interpolation from nearby similar climatic areas.

- Data bases from Geographical Information Systems, such as that available from the Institute of Soil, Climate and Water, as well as from certain universities, are usually able to supply climatic and other data.

8.4.6.3 Farming constraints

Before considering rehabilitation, it is important to clearly establish present constraints on crop production, such as pests and diseases endemic in the area, soils, climate, labour, draught power, inputs and marketing, and agricultural services which unless remedied, are likely to continue to be experienced in the future.

8.4.7 Marketing and Infrastructure

The case studies have shown that effective marketing is crucial to obtaining high gross margins. Conversely, the lack of markets leads to low returns.

- The local market may not always be adequate or popular because of lack of purchasing power among the local community, but nevertheless needs to be taken into account.

- There is a need, particularly on larger schemes, to investigate and establish marketing partnerships with traders and wholesalers, including possible processing of crops on or near the irrigation scheme

- Marketing of any new products should be thoroughly investigated.

- Market prices are essential in order to determine the value of outputs from present and proposed cropping programmes.

- Rehabilitation of irrigation schemes is only justified if there is an assured market. WUAs will need assistance from agricultural economists and other specialists, including processing organisations, in developing suitable marketing outlets for local produce.

- Infrastructure, including access roads, telephone services and electricity are all essential for marketing to function effectively.

8.4.8 Water Supplies

It is important to clearly establish the quality, availability and reliability of the scheme water supply in relation to the area irrigated, crop programmes and technology.

- There are many examples, including two of the case study schemes, where failure to investigate and analyse the quality of water, especially salinity, has led to considerable adverse effects on soils and crop production.

- In considering rehabilitation of schemes dependent on surface water it is important to establish through available hydrological data, the possibility of seasonal shortages in the dry season relative to the rate of abstraction. Here the Department of Water Affairs should be able to provide relevant information.

- Consumptive use of water by a particular crop is usually determined from evapotranspiration data under applicable climatic conditions, and a crop factor relating to the growth stage of the particular crop. The overall crop water requirements can be roughly assessed according to the proportion of each crop in the cropping programme. If necessary, an agronomist should be consulted. The amount of irrigation water in mm depth needed each month is calculated by dividing the net irrigation requirement by irrigation efficiency. An irrigation specialist should be consulted on this.

- The proposed cropping programme will determine the project water demand, as well as the likely benefits of rehabilitation.

- The net irrigation requirement can be calculated by the consumptive unse less 80% of the annual reliable rainfall.

- It may sometimes be necessary to reduce the irrigated area relative to supply.

- One of the case studies has shown that on schemes dependent on ground-water, before incurring additional capital expenditure for rehabilitation, it is important to establish borehole yields by undertaking scientific pumping tests in accordance with accepted criteria.

- The case studies have shown the importance of ensuring that water quality in terms of salinity is within acceptable limits, and that it does not contain levels of sodium, chloride and trace elements which could adversely affect crop growth and soil structure. Where no recent data is available it is important to measure conductivity and have a chemical analysis taken at the water source.

- The overall efficiency of transportation from the source of water to the fields is typically about 60% for surface irrigation and 70% for sprinklers.

- The system on farm efficiency can range from 60 to 95%, depending on the method of irrigation used.

- More often than not, water for household use and livestock is a fundamental basic need. The case studies have shown the need to take cognisance of these needs in calculating overall scheme water requirements.

- Other factors to be considered are the possibility of damage to pumping equipment and lands by seasonal flooding, protection against which may be costly, as well as the possibility of silting up storage dams.

8.4.9 Irrigation infrastructure and technology

- Infrastructure, particularly water supply, needs to cater for irrigation methods, crop choices and economic circumstances. Designs should be specific to community needs and resources. The community through WUAs and Block Commttees should participate in the construction and implementation.

- In the case of gravity fed flood irrigation, the case studies have shown the importance of making a careful evaluation of the state of repair and costs of the main and subsidiary canals.

- In pumping schemes, the state of pumps and motors, as well as in-field sprinkler equipment needs to be carefully assessed and costs obtained from engineers and dealers.

- The state of storage works, especially the degree of silting and costs of removing silt also needs to be assessed, aimed at ease of operation and use.

- Replacement of irrigation technology should be thoroughly investigated and evaluated in co-operation with WUAs, in relation to potential feasibility, acceptability and the ability of farmers to assimilate and use new technology.

- The choice of technology is influenced by manageability, labour requirements, size of plot and distance from the fields. On flood irrigation schemes consideration needs to be given to the short furrow method. With sprinkler irrigation dragline systems are often preferable to conventional moveable pipes. Drip lines and hoses are often suited to small food plots and gardens. *It is important to seek professional advice when re-designing irrigation systems as an integral part of the replanning exercise.*

- Gravity fed schemes generally have much lower running costs than pumping schemes. The most economic delivery system, including adequacy of pump stations, needs to be investigated before any implementation takes place. Where feasible, diesel engines should be replaced with less costly electric motors.

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- An essential requirement for any scheme is for appropriate technologies to measure water use as a basis for volumetric water charges.

8.4.10 Economic indicators

- In considering the viability of rehabilitating individual schemes it is important to assess the present socio-economic situation without rehabilitation, as well as the projected value to participants if the scheme is rehabilitated. Consideration should be given to alternative poverty alleviation measures.

- Estimated benefits must take into account the ability of participants to make optimum use of their own and scheme resources, including the consideration of possible constraints, such as labour availability, education and literacy levels, age structure, knowledge, skills and trainability. Skills can be taught, but will take time to diffuse throughout the scheme.

- The case studies have shown the preponderance of farmers in the upper age groups who tend also to have low levels of literacy. It is important to explore with WUAs and local leaders the possibility of attracting younger farmers to irrigation schemes in conjunction with land reform measures (Refer 8.4.3). This should take into consideration some form of compensation, possibly in the form of a small home garden or food plot.

- If agricultural production figures are available, these should be averaged over good and bad seasons, taking cognisance of the variation between individuals. Corresponding production costs should also be determined in order to assess previous and potential gross margins. Where no local crop production data is available, results from other irrigation schemes and commercial farmers in similar agro-ecological areas will prove useful in assessing previous and potential gross margins.

- There is a need for reliable physical and financial records on individual farms and on the scheme as a whole to provide more detailed data for decision making on individual farms and schemes.

- The difference between the present or previous net incomes and potential income from irrigation farming after rehabilitation provides a reasonable indication of potential benefits. Such benefits need to be measured against the interest and redemption of the cost of rehabilitation. Acceptable levels of benefit will depend on government policy

8.4.11 Rehabilitation, Operation and Maintenance

Once the issues discussed above have been thoroughly assessed and a decision is made to go ahead with modernising and rehabilitating a specific irrigation scheme, the next phase for Agricultural Departments and the Department of Water Affairs is to reach agreement with local communities on rehabilitation, operation and maintenance of the scheme.

In the past, water was supplied either free of charge or at a nominal rate. Even the nominal rate was often not paid due to a culture of non-payment. This was against a background of having to recover operational and maintenance costs for the scheme to stay viable. The policy currently phased in has an objective to recover at least the operational and maintenance costs by means of water charges to ensure viability of the irrigation scheme.

8.4.11.1 Farmer participation

On many small-scale farmer irrigation schemes there is usually some or other farmers' organisation in place. However, their role and degree of participation is often passive, serving simply as a link between top down management and the community. The case studies have clearly shown that one factor contributing to lack of success is limited farmer participation in the whole process of irrigation scheme management.

Results of the case studies showed that the farmers themselves perceived a need for transformation and restructuring of local management of irrigation schemes with clear delineation of responsibilities, water allocations and financial management. From the government point of view there are several advantages in promoting local involvement from the inception of the rehabilitation exercise. Besides substantial savings in running and maintenance costs, local people are keen to assume responsibility and have some experience and knowledge of human resources for construction, repairs and maintenance.

Once the magnitude of the financial and labour inputs for scheme rehabilitation are known, farmers will be in a position to assess the degree of possible financial and labour commitment to scheme rehabilitation, operation and maintenance. Because of the general poverty situation pertaining on most schemes requiring rehabilitation, any financial contribution is likely to be borrowed.

The implementation of farmer participation through WUAs should be looked upon as a "learning process". There will be a need for flexibility and experimentation. Sustainability is likely to depend not on total self-reliance, but initially on a new mixture of local resources with limited external support. Participation should take place at all stages of the rehabilitation process and may take up to three years to implement. At the same time, there needs to be a disengagement plan, specifying when and at what point management will withdraw from active involvement. In esssence this should be based on what would best serve the objective of sustainability of individual irrigation schemes.

will withdraw from active involvement. In esssence this should be based on what would best serve the objective of sustainability of individual irrigation schemes.

There is a need to integrate more women in scheme management as members of WUAs and Block Committees to increase their benefits from projects and to ensure greater participation.

Because some Provincial Agricultural Departments have limited scheme management and rehabilitation capacity, there is merit in handing this task over to appropriate NGOs who are not subject to political pressure and are free from bureaucracy. They are better placed to deal with equity concerns and to target disadvantaged groups. They also have greater flexibility in approach, style and strategy.

8.4.11.2 Water User Associations

- The new National Water Act makes provision for the formation of Water User Associations (WUAs). On all schemes WUAs need to be trained to take over irrigation responsibility of management functions. On large schemes there is a need to form Block Committees to distribute water to individual farmers within the Block, as well as be represented on the WUA. WUAs and Block Committees need to be formally constituted with clear-cut duties and powers. Blocks should be divided into manageable units of 10-20 farmers per water supply outlet.

- There needs to be a benefit to farmers from organising themselves. For example, reduced costs, higher income and/or improved water supply. Farmer organisation is easier with internal cohesiveness within the community. The case studies showed the detrimental effects of internal conflicts within the community. WUAs are likely to succeed if they have legal powers and status and if farmers are secure in their future. The larger the scheme, the more difficult it is for farmers to organise themselves.

- There is a need to initially appoint a skilled **facilitator manager,** particularly on larger schemes, whose role will be to act as a catalyst and assist in identlfying specific needs, initiate, observe, evaluate, provide alternatives and generally assist WUAs and Block Committees in arriving at decisions and acting on them. The facilitator will also assist in identifying roles of WUAs and Block Committees and ensure co-ordination of maangement, maintenance and other support systems, as well a providing feedback to the community. There is a need to ensure that timetables are adhered to and to check guidelines given to WUAs for operational management. The facilitator should preferably be someone who is accepted by, and has a definite interest in, the community.

- Implementation of management transfer to WUAs should be preceded by comprehensive and participatory strategic planning of the issues discussed earlier, including a clear definition of roles and a timetable for transfer. The Facilitator has an

important role to play in identifying leaders for WUAs and Block Committees so that farmers can effectively participate in management.

- Over time, WUAs need to adopt performance-oriented management techniques. This requires a set of incentives and commensurate accountability. Accountability requires that there be specified performance levels at points of transfer of management responsibility to enable both the handing over agency and the WUA to agree on the task and the level of service required.

- WUAs may not initially be prepared for total and abrupt withdrawals after transfer. The period of withdrawal should depend largely on how well prepared and trained farmers are to take over management. Any new partnership should be negotiated with management. Clearly, the profitability of irrigated agriculture and the relative cost of water are factors which will determine the farmers' capacity and willingness to take over the management of irrigation systems.

- It is important that a WUA be in place before any rehabilitation work begins. Scheme objectives, terms of reference, legal powers, rights and obligations should be clear at the outset.

- Gender composition of WUAs should reflect the productive labour situation on the scheme.

- The size of the basic unit of operation can be crucial. Block Committee areas larger than twenty participants may be difficult to operate. More important is a common interest. The normal basis for a Block Committee on larger schemes would be a common water supply system. Each Block Committee should be represented on the WUA.

8.4.11.3 Upgrading infrastructure

It is important that the WUAs, Block Committees and the local community are consulted and involved in the exercise of upgrading the infrastructure. This applies particularly for providing labour for specific tasks.

8.4.11.4 Operation and maintenance

- The case studies have shown that scheme maintenance is a major stumbling block. Operation and maintenance tasks of the scheme should be within the potential capacity of the WUA. Initially, training and assistance will need to be provided by the Departments of Agriculture and Water Affairs, until such time as WUA staff have the necessary competence to take over these functions.

- The application of irrigation scheduling methods depends on irrigation policy, type of infrastructure, the level of acceptance of planned methods by WUAs and Block

Committees, scheme operators appointed by WUAs, and the farmers. A simplified approach based on crop requirements ensuring a fair water distribution should be aimed at.

- Effective scheduling requires good communication between those responsible for water delivery, water distribution and water application.

- Recovery of water costs based on volumetric payment is not feasible on small-scale farmer schemes. A *pro rata* affordable flat rate based on size of plot levied by the WUA is the only practical alternative.

8.4.11.5 Farming credit

- The case studies have shown that many small-scale irrigation farmers, especially food plot holders lack the necessary financial resources for inputs and services.

- Credit needs fall into two categories: medium term credit where farmers are contributing to the cost of scheme rehabilitation, and short term credit to cover seasonal production costs.

- Medium and short term credit is available through the Land Bank and other farming credit institutions. Individual production loans should be on a selective basis on the recommendation of WUAs, with preference given to farmers with proven ability and/or willing to accept extension advice on irrigation farming.

8.4.11.6 Farming inputs

An important role of WUAs is to liaise with input suppliers to supply appropriate inputs in bulk, at reasonable cost and in good time for the season.

8.4.11.7 Mechanisation

Results from the case studies have shown that lack of, or inadequate ploughing services is a serious constraint on many small-scale farmer irrigation schemes, resulting in late planting and consequent low yields. It is incumbent on WUAs to negotiate with contractors, as well as investigate the possibility of ox drawn tillage and small tractors. The possibilities of minimum tillage techniques also need to be investigated.

8.4.11.8 Extension and training

- This study has shown that extension workers are often ill prepared to give sound advice on irrigation techniques, irrigated crops and vegetables. A pre-requisite for successful scheme rehabilitation is to place well trained competent extension officers on the scheme, who, together with the project facilitator, can commence training farmers from the outset.

- There is a need to reform government extension services with training aimed at new strengths in irrigation techniques and technology. The provision of extension services can be made more effective by targeting them to the category of people in most need of irrigation transformation.

- Agricultural Departments should upgrade irrigation extension services to provide specialist irrigation advice. This can be undertaken by Departmental Specialists and/or Agricultural Research Council scientists.

- There is a need to develop the capacity of WUAs and Block Committees in concepts of crop water requirements and water saving methods for efficient utilisation of water.

- Results from the case studies suggest that despite many farmers having been involved in irrigation farming for a number of years, many still have a low knowledge of water management and irrigation techniques.

- Irrigation extension officers should formulate local extension programmes in consultation with WUAs and Block Committees, and be accountable to the WUA.

- The method of technology transfer for women and older illiterate or semi-literate farmers needs to be appropriate to their needs.

- Training needs to be preceded by participatory analysed training needs with WUAs, extension workers and farmers.

- To be effective there must be a facilitator to guide training. Training is a low cost method of motivating extension workers, WUAs, Block Committees and individual farmers. The facilitator needs to be *au fait* with irrigation rules, operation and maintenance practices, and conflict management.

- Training of WUAs and Block Committees in water application, monitoring and control of water distribution systems, as well as in scheme maintenance such as cleaning, weeding and desilting canals, is vital for sustained success

- On larger schemes, specialised training for technical functions, such as pump technicians and water bailiffs is fundamental for successful scheme operation.

- As a general rule both the context and methodology of training programmes need to be appropriate to the various target groups, including WUAs, farmers, extension workers, managers and administrators. To be effective, the emphasis should be on "learning by doing" on-the-job. Initially the emphasis should be on "training trainers". It is important to start with what the target group knows and build from there.

- De Lange, Adendorff and Crosby (1988) provide useful guidelines for training programmes for those involved in irrigation scheme management and development. These include farmers, those involved in water supply operations, water bailiffs and maintenance staff, scheme managers, extension officers and mechanisation contractors. These authors also provide guidelines for input suppliers, marketing organisations, planners and designers, infrastructure contractors and policy makers.

8.4.11.9 Research

The study has shown that on-farm research is a much neglected, but esssential part of small-scale farmer irrigation scheme development. Research is needed, not only in new and alternative high value crops, but also in determining real crop water requirements. There is also a need to consider integrating livestock and developing farming systems, which may include livestock and dryland farming. This will require a multi-disciplinary diagnostic approach to determine priority problems to be addressed by applied adaptive on-farm research, focusing on overcoming constraints to irrigated crop and vegetable production.

8.4.12 Conclusion

The above check list (Table 8.5) is not exhaustive. However, if one or more of the elements discussed above are inadequately addressed it is unlikely that productivity of the scheme will be at an optimum level. Empowerment and capacity building are crucial for the successful rehabilitation, continuity and sustainability of small-scale farmer irrigation schemes. Representatives of Agricultural Departments, the Department of Water Affairs, and the Department of Land Affairs need to liaise with local structures in facilitating the rehabilitation of selected irrigation schemes.

8.5 THE PARTICIPATORY PROCESS

Experience has shown that a participatory process which generates a sense of involvement and ownership is essential for successful rehabilitation and long term sustainability of small-scale farmer irrigation schemes. The participatory process for scheme rehabilitation should involve the following steps:

- The scheme facilitator encourages existing scheme structures to request assistance from the Provincial Department of Agriculture and the Department of Water Affairs to rehabilitate the scheme.

- The local structure (farmers' committee) submits a formal written request to the Provincial Department of Agriculture (PDA) and the Department of Water Affairs (DWA) for assistance in rehabilitating the scheme, indicating their willingness to participate.

- Following an assessment by the PDA, dialogue is initiated through the scheme facilitator aimed at establishing a WUA, as well as Block Committees.

- Once a WUA committee is elected, the legal obligations of WUAs and Block Committes need to be discussed and agreed upon by the WUA.

- A clear form of written agreement on the obligations and contributions of WUAs and participants in rehabilitation, management, maintenance, operation and funding of the scheme needs to be signed and accepted by the PDA and the WUA.

- Meetings need to be set up between the WUA, PDA and DWA to reach agreement on the tasks and training required to rehabilitate the scheme. The handing over of responsibility to the WUA is likely to be on an agreed phased basis.

- A rehabilitation implementation agreement between the WUA, PDA and DWA specifying respective tasks and funding details and responsibility needs to be finalised.

- A written agreement on water charges, infrastructure and maintenance costs to be finalised.

- The project facilitator to organise with the WUA and Block Committees the allocation of tasks for management operation and maintenance of the scheme accompanied by an intensive on-the-job training programme.

- The PDA and DWA to hand over scheme infrastructure to the WUA.

- The above check-list, as well as the check list in Table 5, should be employed following an initial request for rehabilitation assistance in order to confirm or otherwise whether there are any major constraints to the proposed rehabilitation. The check-list requires an input by a team of senior specialist and extension staff. A rigorous approach is needed to the economic aspects of scheme rehabilitation.

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Appendix 1

BULULWANE IRRIGATION SCHEME

INTRODUCTION

Explain the purpose of the interview to the respondent. Stress that before problems of the scheme can be solved, it is necessary to understand the problems. Explain that all information given is CONFIDENTIAL, and will be processed by computer and added to the information given by others. For this reason it is necessary to establish the TRUE situation. Explain that on completion of the survey the findings will be discussed with the community.

1. NAME of person interviewed ..... No. .....
   Block No. .....

2. a) Irrigated plot size.....ha Dryland .....ha (1 dec. point)
   b) Year plot was allocated 19 ....

3. Position of person interviewed in household:
   1. Male head 2. Wife 3. Female head or widow 4. Son
   5. Daughter 6. Grandfather 7. Grandmother

4. Plot allotted to: 1. Male head 2. Female head 3. Other (specify)

5 a) Marital status of head of household 1. Married 2. Widowed/divorced
   b) 2. Resident 1. Working away

6. Age of head of household .....years

7. Years of education : Male head .....years Female head ..... years
   (one or other as per 4)
8. Fulltime employment (type of job)
   Male head ..... Female head .....
   Sons (No.) ..... Daughters (No.) .....

9. Household members in receipt of pensions (No.) .....

10. Family size : a) No. living at home .....
    b) No. living away from home.....

11. Can you tell me what your family spends per month on food, clothing, education, health, drink, cigarettes, travel etc. R .....

12. How much is spent per month on food for the family R .....
Are you able to save any money? 2. Yes 1. No

13. Do you consider your family is getting enough food to eat?
2. Yes 1. No

14. What do you consider the value of crops produced this year R ..... (Enumerator to assess)

15. In order of importance, what vegetables or crops are you growing? .....
.....

16. a) Are there any other crops or vegetables you would like to grow?
.....
b) What do you think is the most profitable crop to grow?
.....

17. a) How many bags of maize did you produce last year?
.....bags (Enumerator to assess)
b) How many bags of maize did you buy over the past 12 months?
.....bags
c) Do you grow maize mainly for a) grain or b) green maize

18. Who decides on which crops to grow? .....

19. a) What animals does the household own?
a) Cattle No..... b) Goats No .....
c) Sheep No..... d) Pigs No.....
e)Chickens (Broilers) ..... f) Chickens (layers) .....
(obtain from veterinary records)

b) What animals did the household sell over the past 12 months?
Cattle no..... Goats no. .....Sheep no. .....

20. a) Are you satisfied with the present security of land 2. Yes 1. No
b) If no, how can it be improved? .....
.....

21. a) Do you think your plot size is 1. Too large 2. Just right
3. Too small
b) Do you feel people should be able to sell their plots to others?
2. Yes 1. No
c) If no, why not? .....

d) Do you wish to acquire more land? 2. Yes 1. No

22. What did you originally hope to gain from the project?

.....

23. What has given you the most problems on the scheme?.....

.....

24. a) Did you have to borrow money for inputs? 2. Yes 1. No
b) Were you able to repay the loan? 2. Yes 1. No
c) If no, why not? .....

.....

25. If marketing of crops and vegetables was a problem, explain why

.....

.....

26. a) If you were gettting enough money from your plot, would you be prepared to pay for water? 2. Yes 1. No
b) If no, why not?.....

.....

27. Do you feel that in the future farmers should participate more in the management of the scheme and **in what way?**.....

.....

28 a) Are you satisfied with the role of the Farmers' Committee on the project? 2. Yes 1. No
b) If No, what can be done to improve matters? .....

.....

29. Who makes the decisions? (Tick one block per line)

	Husband	Wife	Husband/wife	others (specify)
Crops to be planted				
Inputs to be purchased				
Household labour				
Marketing				
Household expenditure				

30 a) If there are conflicts on the scheme, explain the nature of the conflict .....

.....

b) how can it be solved? .....

.....

31 a) Are you satisfied with the scheme management ?
2. Yes 1. No
b) If no, why not? .....
.....

32. For what reason do you think the scheme was established?
.....
.....

33. Do you think farmers should play a greater role in the following: (tick)
a) General decision making 2. Yes 1. No
b) Water distribution 2. Yes 1. No
c) Water allocation 2. Yes 1. No
d) Decisions on scheme financing 2. Yes 1. No.

34 a) Do you think farmers are adequately trained to participate in the scheme? 2. Yes 1. No.
What further training is required? .....
.....
b) What further training do you require .....
.....

35. What are the most important needs to rehabilitate the scheme?
.....
.....

36. In the past, would you say :
there was always enough water (1)
enough, but not always (2)
never enough? (3)

37. How would you rate the project management:-
a) 5. Very good 4. Good 3. Average 2. Poor 1. Very poor
b) Why is this? .....
.....

38. a) Who did the following tasks on the plot?
(Enumerator to tick one block on each line)

	Husband	Husband + wife	wife	other
Planting				
Irrigating				
Weed control				
Harvesting				
Selling				

b) Which task requires the most labour?.....
c) Do you ever hire labour? 2. Yes 1. No
Number of labour days per year (estimate)..... days
d) Who does the land preparation? .....
.....
e) Are you satisfied with the ploughing services? Yes No

39. For how many years have you been irrigating? .....Years

40. a) How often do you irrigate in summer? Every ..... days
b) Do you feel there is a problem with the quality of water?
1. Yes 2.No
c) Do you feel there is a porblem with the quality of soil?
2. Yes 1.No

41. a) Were you satisfied with communication between the Farmers Committee and Project Management? 2. Yes 1. No

b) Were you satisfied with communication between the Farmers committee and members? 2. Yes 1. No

42 a) Do you feel farmers could manage the scheme?
2. Yes 1. No
b) If No, what outside assistance would be needed? .....
.....
c) Who should manage the scheme in the future? .....
.....

43 a) Who do you go to for advice if you experience a problem on your irrigation plot? .....
.....
b) Do you get good advice? Yes No

c) would you prefer your extension officer to be 1) a man or
2) a woman? (Tick)

44 a) How has irrigation affected women? .....

.....

b) Do you agree with these statements concerning the irrigation scheme?

	2.Yes	1.No
Women work longer hours	.....	
Previously women had more food for their chickens	.....	
Women have less access to land than before	.....	
Women are more dependant on their husbands	.....	
Women have less opportunities to earn some income of their own	.....	

45 Tools and Resources

	2.YES	1.NO
Tractor	.....	
Ox plough	.....	
Ox cultivator	.....	
Bicycle	.....	
Bakkie	.....	
Motor car	.....	
Ox planter	.....	
Trailer	.....	
Hoes No.	.....	
Spades No.	.....	
Forks No.	.....	

46. Which organisations do you belong to? .....

.....

47. Do you have any further suggestions on what can be done to rehabilitate the scheme?.....

Appendix 2

STRUCTURED GROUP INTERVIEWS
NON-PARTICIPANTS

INTRODUCTION : The purpose of this discussion is to get your ideas and suggestions on the problems and what can be done to rehabilitate the scheme. This is part of a project of the WATER RESEARCH COMISSION to look at ways and means of rehabilitating the scheme. What you have to say will be treated in strict confidence, so please feel free to give your feelings and opinions.

Note: Enumerator to tick Yes or No answers.

1. GROUP (Describe group - organisations and gender composition and number)

.....

.....

2. Why do you think the irrigation scheme was started? .....

.....

3. What benefit has the scheme been to participants?.....

.....

4. What benefit has the scheme been to the area as a whole? .....

.....

5. Were the people adequately consulted before the scheme was started (specify).....

.....

.....

6. a) How were scheme participants selected?.....

.....

.....

b) Are you satisfied with the way participants were selected? Yes No

If No, what was wrong with the method of selection? .....

.....

c) Are there people who would have liked to participate but could not get a plot?

Yes No.

d) If Yes, approximately how many people do you think could not get land?

.....

7. What improvements and development in the area have come about since the scheme started?.....

.....

8. a) Do you feel the scheme should be rehabilitated? Yes No

b) If Yes, what needs to be done?.....

.....

c) If No, why not?.....

.....

9. Should farmers be given title to the land, or should the present land tenure system remain in force?...(specify).....

.....

.....

10. Do you think living standards are better or worse than before the scheme started? (Specify) .....

.....

11. a) Do you think the previous management were doing a good job? Yes No

b) Do you think the present management are doing a good job? Yes No

c) If No, what can be done to improve management? .....

.....

.....

12. In what way do you think people not participating in the scheme have benefited? (Specify) .....

.....

13. a) Do you think farmers have adequately participated in running the scheme?

Yes No.

b) If No, in what way should they participate in the future?.....

.....

14.a) Have there been any conflicts on the scheme? Yes No

b) If Yes, what were these conflicts about? (Describe) .....

.....

15. a) Do you think the farmers' committee are doing a good job? Yes No

b) If No, in what way can the situation be improved? (Describe) .....

.....

.....

16.a) Do women play an important role in participating in the scheme? Yes No

b) If No, how can this be improved (Describe) .....

.....

17.a) Do you think any new diseases have come into the area since the scheme was started? Yes No

b) If Yes, what diseases were these? .....

.....

18. a) Does the scheme enjoy good political support? Yes No

b) If No, what is the problem? (Describe) .....

.....

19. a) Finally, what other suggestions do you have for improving the irrigation scheme?

.....

.....

b) Do you have any suggestions for alleviating poverty in the area as a whole? (Specify)

.....

.....

c) What further services do the community need to improve living standards? (Specify)

.....

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